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TECHNICAL MANUAL

75-MM GUN MATERIEL, M1897
AND MODIFICATIONS

March 31, 1941

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WAR DEPARTMENT,
WASHINGTON, March 31, 1941.

75-MM GUN MATÉRIEL, M1897, AND MODIFICATIONS

Prepared under direction of the
Chief of Ordnance

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CHAPTER 1

GENERAL

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1. Purpose.—This manual is published for the information and guidance of the using arms and services.

2. Scope.—*a.* In addition to description and figures, this manual contains instructions for the operation, inspection, disassembly and assembly, repair, and care and preservation of the matériel.

*This pamphlet supersedes TR 320-95, March 25, 1925 (including C1, January 3, 1927), and in part TR 1305-A, February 1, 1933.

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b. Disassembly and assembly and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope and/or facilities of the battery personnel, the local or otherwise designated ordnance service should be informed in order that trained personnel with suitable tools and equipment may be provided or proper instructions issued.

3. References.—All Technical Manuals, Field Manuals, Firing Tables, Standard Nomenclature Lists, and other publications pertaining to the matériel described herein are listed in the appendix.

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4. Data pertaining to guns.—a. Weight.

75-mm gun		Weight (pounds)
M1897-----		1, 015
M1897A2-----		1, 035
M1897A3-----		1, 035
M1897A4-----		1, 035

b. Rate of fire.—A maximum rate of fire of 25 to 28 rounds per minute may be attained, but the advisable rate is 6 rounds. The gun may be loaded at any angle of elevation or depression.

5. Data pertaining to gun carriages.—a. General.

75-mm gun carriage	M1897	M1897M1A2	M1897A4	M2A1	M2A2	M2A3
Weight of gun and carriage, complete (without accessories)-----pounds	2, 657	2, 657	3, 007	3, 447	3, 447	3, 225
Length of recoil-----inches	44. 9	44. 9	44. 9	41. 5—	41. 5—	44. 9
Height of axis from ground-----inches	40. 4	40. 4	44. 4	47 $\frac{1}{2}$	47 $\frac{1}{2}$	47 $\frac{1}{2}$
Maximum elevation degrees	19	19	19	46	46	45°30'

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75-mm gun carriage	M1897	M1897M1A2	M1897A4	M2A1	M2A2	M2A3
Maximum depression degrees	10	10	10	10	10	10°30'
Maximum traverse, right degrees	3	3	3	45	45	3°
Maximum traverse, left degrees	3	3	3	40	40	3°

b. Table of recoil mechanisms and carriages.—The table below gives the guns and recoil mechanisms (columns one and two) which are mounted on any carriage (column three). Reading across, any of the guns or recoil mechanisms listed in any one row may be mounted on any of the carriages in the same row.

Gun	Recoil mechanism	Mounted on 75-mm gun carriage
M1897	M1897A3	M1897
M1897A1	M1897A6	M1897A2
M1897A2		M1897M1
M1897A3		M1897M1A2
M1897A4		M1897A4
M1897A2	M1897A5	M2A1
M1897A4		M2A2
M1897A2	M1897A7	M2A3
M1897A2	M2	M2A1
M1897A4		M2A2
		M2A3

SECTION II**DESCRIPTION AND OPERATION**

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6. Description of 75-mm guns.—*a. M1897.*—(1) The gun (fig. 5) is of French design. A number of these weapons were purchased by the United States. Similar guns were manufactured in

this country. The parts of the American and French manufactured guns are identical and therefore interchangeable.

(2) The gun is the built-up type. Name and model are stamped on the left side of breech hoop. Name of manufacturer, year of manufacture, serial number, and weight, including breech mechanism, are stamped on the muzzle. Data on guns bought from France will be found on top of breech end.

b. M1897A4 and M1897A2.—(1) The M1897A4 gun (fig. 6) is a modification of the 75-mm gun, M1897 (French). The modification consists of the removal of rollers and sweeper plates with felt pads, and elimination of a portion of the jacket of the gun which is replaced by steel rails and bronze strips attached to supports on the gun.

(2) The M1897A2 gun is standard for new manufacture and is similar in design to the 75-mm gun, M1897A4.

7. Description of breechblock.—*a.* The breechblock (fig. 7) is the Nordenfeld eccentric screw type, cylindrical in shape, and threaded on its exterior to fit the breech recess. It has a large diameter compared with the caliber of the gun due to the axis of the breech recess and breechblock being below the axis of the bore of the gun. With this type the breechblock remains in the breech recess during the action of both loading and firing, and the opening and closing of the breech is accomplished by rotating the breechblock 156° around its axis by means of the operating handle. This movement alternately locates the loading hole and the firing pin in line with the chamber of the gun, the movement being limited in each direction by stops against which the breechblock arm strikes. While the mechanism is in the closed position, it is automatically locked until released by action of recoil. The rim of the rear sight serves as a cam to trip the breechblock latch.

b. The gun cannot be fired until the breechblock is rotated to the fully closed position, as only at that point is the firing pin in line with the primer. Rotation of the breechblock to the loading position automatically ejects the empty cartridge case.

c. Two leveling plates in the top of the breech hoop form a surface parallel with the bore, for the application of the gunner's quadrant.

8. Operation of breech and firing mechanism.—*a. Breech mechanism.*—(1) *To open breech.*—Unlatch breechblock latch by pressing on operating handle plunger with the thumb. Grasp operating handle with both hands toward the forward position. This will protect the little finger of left hand from danger of injury by

crushing between the pawl and rear sight. Pull upward and push over to left until breechblock arm stops against breechblock stop.

(2) *To close breech.*—Grasp operating handle as in opening the breech, and pull to the right and down until breechblock arm strikes projection stop on lower right on breech face. At the end of this movement the inner end of breechblock latch springs into the grooves in the latch catch in breech face of the gun, latching the breech mechanism in closed position.

b. *Firing mechanism.*—(1) To fire the piece, pull lanyard sharply down and to the right and release lanyard. This allows the hammer to be thrown forward against the firing pin by means of the firing rack spring with sufficient force to explode the primer.

(2) Safety piece (fig. 7) is provided to prevent accidental firing. The safety piece screws into the threaded recess in the breechblock arm, and may be located at two different points. These two points are marked Safe and Fire on the outer surface of the breechblock arm. (On guns of French manufacture, these two points are marked Tir and Route.)

9. *Description of carriages.*—a. *M1897, M1897A2, M1897MI, M1897MIA2, and M1897A4.*—(1) *General.*—(a) These gun carriages are of the hydropneumatic, constant recoil type in which the gun when fired recoils a sufficient length to permit the carriage to remain stationary.

(b) The 75-mm gun carriage M1897 (French) (fig. 9), was designed and manufactured in France. The 75-mm gun carriages manufactured in this country are designated M1897MI.

(c) When the M1897 or M1897MI carriages are equipped with handspike, model designation of the M1897 carriage is changed to M1897A2 and of the M1897MI carriage is changed to M1897MIA2.

(d) When the M1897 (fig. 9), M1897A2, M1897MI (fig. 17), and M1897MIA2 (fig. 11) carriages are equipped with high speed adapters, their model designation is changed to M1897A4 (fig. 12).

(2) *Recoil mechanism.*—(a) The recoil mechanism controls the force created by firing and checks movement of recoiling mass in a gradual manner so as not to cause displacement of the carriage. The recuperator system of the mechanism returns the recoiling mass into battery in order that the gun may be fired again.

(b) All recoil mechanisms, except the M1897, have been equipped with a respirator, which acts in conjunction with the recuperator in regulating counterrecoil at different temperatures. The respirator head has four indentations in which the respirator cap spring seats when the valve is rotated. These indentations are numbered 0, 1, 2 and 3, indi-

cating the number of holes which may be opened to allow escape of air from the recoil cylinder during counterrecoil.

(3) *Elevating mechanism*.—Located between rocker and cradle. Its function is to elevate or depress the gun with reference to the rocker. Thus the gun can be laid to the desired angle of elevation for range without disturbing the laying for angle of site or the line of sight ((5) below).

(4) *Range rack and range scale mounting*.—Range rack (fig. 15), range scale, and range rack guide, front, have engraved scales which correspond to the various ranges. The scales are for setting the gun in elevation or depression. Spacing of the graduations is such that when the gun is elevated or depressed, the graduation opposite the index indicates the actual range. The range rack and the range scale are graduated for range in meters. The range rack registers for every 100 meters, and the range scale for every 50 meters. The range rack guide, front, is graduated for every 2 mils. Thus to set the gun for a given range, elevate or depress gun until corresponding graduation of the scale is opposite the index. If the range is given in meters the scale on the rack is used. If it is given in mils the scale on the range rack guide, front, is used.

(a) Range scale is located above elevating crank on right of carriage.

(b) Any movement between rocker and cradle is indicated by the range scale.

(c) Index marks on front and rear guides register the range and elevation on the range rack scale and range rack.

(5) *Angle of site mechanism*.—(a) The angle of site mechanism is located between trail and rocker, and provides means for elevating or depressing the rocker with reference to the trail. By means of this mechanism the rocker can be laid to the desired angle of site without disturbing the angle of elevation.

(b) The angle of site handwheel (figs. 11 and 16) is perforated with twelve holes which can be engaged with its angle of site handwheel latch (fig. 16) thus locking the angle of site mechanism. The outer face of the angle of site handwheel is divided into 16 equal spaces which are stamped and numbered. One complete turn elevates or depresses the rocker 16 mils.

(c) The angle of site pointer (figs. 11 and 16) is a reference for reading graduations on the outer face of the angle of site handwheel.

(6) *Traversing mechanism*.—The carriage can be trained on a target by shifting the trail. A means is provided, however, for closer training through the traversing mechanism. In traversing the carriage

the front of the trail slides laterally on its bearings on the axle, describing an arc about the spade. Thus during traverse one wheel advances slightly ahead of the other.

(7) *Shield*.—The shield is for protection of the gun crew. The three types of shields are a four-piece shield of American manufacture, a four-piece shield of French manufacture, and a seven-piece shield. The American four-piece shield is interchangeable with the French four-piece shield, and either may be used to replace the seven-piece shield. However, the seven-piece shield cannot be substituted on a carriage fitted for either type of four-piece shield.

(8) *Wheels*.—There are two types of 14-spoke wheels, one steel-tired and the other rubber-tired. They are interchangeable on M1897 and M1897M1A2 carriages.

(9) *Wheel fastenings*.—The wheel fastenings consist of axle collars fitted with leather washers and keyed to the axle at the inner ends of the hubs, and axle caps fitted with leather washers held in position by linchpins.

(a) Axle collars are rigidly keyed to the axle and take the lateral thrust of the wheels when traveling.

(b) Axle caps are held in place by means of linchpins. The outer surfaces of the axle caps bear against the linchpins. The axle caps are so made that there are three separate surfaces that can be brought to bear against the sides of the linchpins, each surface being higher than the other. Thus a means of adjustment for end play is provided. By varying the thickness of the washers in hubs, axle collars, and axle caps, end play may be eliminated.

(c) The linchpins are provided with latches which are forced down over the ends of the axles clamping the pins in position. Leather thongs hold the linchpin latches in position.

b. *M1897A4*.—(1) The carriage (fig. 12) is a modified 75-mm gun carriage, M1897 or M1897MI. This modification consists of the removal of seats, seat supports, shaft brackets, steel or rubber-tired wheels, brake worm support bolts and washers, brake crank pin and brake crank, and equipping the carriage with a high speed adapter, pneumatic tires mounted on disk and rim wheels, and an internal expanding brake mechanism.

(2) In other respects the carriage is the same as the M1897 carriage.

c. *M2A2*.—(1) The carriage (fig. 27) is of the split trail type built for high speed transport and equipped with pneumatic tired disk and rim wheels with internal expanding brakes. Equilibrators neutralize unbalanced weight of the gun and recoil mechanism.

When traveling an offset drawbar provides the spades with road clearance and two locking mechanisms secure the traversing mechanism.

(2) (a) Elevating and traversing the weapon are accomplished by elevating and traversing handwheels.

(b) Stops are provided to control maximum elevation, depression, and traverse. Trails are spread 90° for maximum traverse. When spread 45° the traverse is controlled by a stop on the traversing mechanism.

(3) When firing with the trails locked together the firing jack is not to be manipulated to support the carriage weight, as a three-point support is necessary and consists of the two wheels at the front and the spade end of the trails at the rear. However, under this condition care must be exercised to insure that the total traverse does not exceed 520 mils or the elevation exceed 380 mils.

(4) When the carriage is emplaced with the trails spread, the firing jack will be used to form a three-point support, consisting of the jack and the spades. However, on level ground the piece may be fired safely from the wheels with the trails in either of the spread positions.

(5) Height of the jack is immaterial if it is such as to raise the wheels. On soft ground the jack may sink. It may therefore be necessary to jack up the carriage from time to time. The trails when spread for firing have two symmetrical positions. If necessary, however, one trail may be spread 45° and the other $22\frac{1}{2}^{\circ}$, if the site has obstructions to prevent spreading both trails to the $22\frac{1}{2}^{\circ}$ or 45° positions.

(6) The recoil mechanism for this carriage is that of the 75-mm gun carriage, M1897 (French), modified by removing the elevating mechanism and mounting in a cradle in order to move axis of elevation of the gun to the rear, thereby attaining a greater maximum elevation (fig. 18).

(7) The cradle is of built-up steel construction. The recoil mechanism is assembled to the cradle by trunnions seated in bearings at the rear of the cradle. Rear of the recoil mechanism is supported on brackets and secured by studs.

d. M2A3.—(1) The carriage, M2A3 (figs. 33 and 34), is a modification of the 75-mm gun carriage, M2 (fig. 27). This modification consists of the following changes:

(a) Firing jack is eliminated and the carriage is equipped with a pivoted axle which automatically adjusts itself to permit laying the piece with the wheels at an angle up to 10° to the horizontal.

(b) Top carriage modification consists of removing and relocating of various pads, brackets, and bosses and adding other parts to mounting and elevating mechanism handwheel on the left hand side of the carriage, and to provide for cradle and traveling locks. The lower part of the top carriage is modified to provide clearance for the pivoted axle.

(c) Trails and spades are modified by reducing the length 19 inches. The drawbar is designed for use with a motorized unit.

(2) The recoil mechanism, T7, combines the cradle, recoil, and recuperator (counterrecoil) cylinders. Its function is to check movement of recoiling mass in recoil and counterrecoil in a gradual manner so as not to cause displacement of the carriage.

(3) Other characteristics of the M2A3 carriage are similar to the M2A1 and M2A2 carriages and for detailed information regarding these characteristics reference should be made to these carriages as set forth in this manual.

(4) The gun mounted on the M2A3 carriage is the M1897A4 (fig. 6).

10. **Operation of carriages.**—*a. M1897, M1897M1A2, and M1897A4.*—(1) *To elevate.*—Elevating crank is on right side of carriage. To elevate, the crank is turned counterclockwise; to depress, it is turned in the opposite direction. One complete turn of elevating crank (figs. 9 and 15) elevates or depresses gun and cradle 8 mils. Limitations of the carriage allow 213 mils (12°) elevation and 0 mils (0°) depression of cradle.

(2) *To set angle of site.*—Angle of site handwheel (figs. 11 and 16) is located on left side of carriage. Release the angle of site handwheel by means of the angle of site handwheel latch handle. Clockwise movement elevates and counterclockwise depresses. One complete turn of the handwheel in one or the other direction elevates or depresses the gun 16 mils.

(3) *To traverse.*—Traversing handwheel (figs. 11 and 16) is on left side. Clockwise rotation of handwheel traverses carriage to left and counterclockwise to right. One turn of handwheel traverses carriage 1.8 mils. Limitations of the carriage allow traverse of 53 mils (3°) right and 53 mils (3°) left.

(4) *To place M1897 or M1897M1A2 carriage in abatage.*—To place in firing position on brake frame, place a man on each side of the trail (fig. 10). Each man grasps a tie rod at the end nearest the right brake beam, lifting it up as far as it will go. Brake latch pin in right brake shaft lever is lifted out of engagement with the lug on the right seat support, and brake shaft levers are pulled back from under brake

beam crank tubes, allowing lower end of brake beam frame with its brake shoes to fall to the ground behind the wheels. Lift rear of trail approximately 3 feet from the ground and pull back on trail. Lower trail, so that the carriage rotates about the spades, and wheels roll back onto brake shoes (fig. 17).

(5) *To remove M1897 or M1897M1A2 carriage from abatage.*—Reverse operations in (4) above.

b. *M2A2.*—(1) *Elevation.*—Elevating handwheel (fig. 26) is located on right side of top carriage. Stops control elevation and depression.

(2) *Traverse.*—Traversing handwheel (figs. 25 and 27) is located on left side. Traverse depends upon the spread of the trails. When trails are spread to the limit and locked the gun may be traversed 85°. When trails are spread 45°, traverse is limited by a stop on the traversing mechanism to 45°.

(3) *Firing to traveling position.*—To change from firing to traveling position it is necessary to release the firing jack (figs. 21 and 27). This is accomplished by placing right handspike part way into its socket (fig. 21). Raise jack sufficiently to release tension on the shot bolt. Withdraw shot bolt with left hand and secure it in its disengaged position. Standing clear of the gun barrel, quickly pull out handspike from its socket.

(a) Disengage firing jack from axle by pressing on the jack release pedal (fig. 21). Then swing firing jack up and toward the muzzle of the gun and manipulate the cradle by means of the elevating and traversing handwheels until arm of firing jack enters its seat on cradle and is locked in place by cradle lock pin (fig. 24). Rotate cradle lock pin handle 90° upward, then seat and secure it by the turnbuckle. Secure traveling lock located on left of top carriage by rotating it to its rearward position.

(b) Withdraw trail lock pins. Close trails and lock them together by means of trail connection hook handle (fig. 31).

(c) Turn drawbar downward and lock in this position by means of drawbar lock shaft.

(d) Mount accessories to trails and release wheel brakes.

(4) *Traveling to firing position.*—To change from traveling to firing position reverse the operations previously described. In order to jack up carriage insert both handspikes in firing jack sockets with bent ends of ratchet plunger pins to the outside, and operate handspikes alternately. Insure that spring plunger knob is correctly set to control maximum traverse for the selected trail spread.

c. *M2A3 (figs. 33 and 34).*—(1) *To change from traveling to firing position.*—Disengage lunette from pintle of prime mover. Lower trails to the ground. Release trail lock and spread trails and lock them in position by means of trail lock pins. Release axle lock, traveling lock, and cradle lock. Lower apron and raise top shield and lock in position. Set brakes.

(2) *To change from firing to traveling position.*—Lower top shield and secure it in position. Bring gun in position to engage cradle lock. Withdraw trail lock pins and close trails and engage trail lock. Engage axle lock to secure axle to the support. Engage traveling lock. Secure drawbar in position with lunette down. Release brakes. Insert lunette into pintle of prime mover and secure by pintle latch.

SECTION III

DISASSEMBLY AND ASSEMBLY

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11. **General.**—a. Incidents of wear, breakage, cleaning, and inspecting make necessary the occasional disassembly of various parts of the gun and carriage. This work comes under two headings, that which may be performed by battery personnel and that which is performed by ordnance personnel.

b. Battery personnel may in general do such dismounting as is required for the assembling of parts indicated in Standard Nomenclature Lists Nos. C-4, C-12, and C-25. Such work should be done in the manner prescribed. Any difficulty which cannot be overcome should be brought to the attention of ordnance personnel.

c. Battery personnel will not attempt to disassemble any part of the

recoil mechanism not authorized, nor do any filing on the sights or gun parts other than outlined, and only by order of the battery commander.

d. Use of wrenches which do not fit snugly on any part should be avoided. They will only fail and will damage the corners of the nuts or bolt heads. Also there is danger of spreading the wrenches and rendering them useless.

e. In assembling, assembly of subassemblies should be completed before attempting to assemble the larger ones in which the subassemblies are placed. In all assembling, bearings, sliding surfaces, threads, etc., should be cleaned and lubricated.

12. Disassembly of breech mechanism and breechblock.—*a.* *Breech mechanism.*—(1) With breech closed and locked, release breechblock stop (fig. 7) by turning breechblock stop pin until it can be pulled upward through keyway in the stop. After this operation, swing the stop outward which releases extractor spindle. Pull extractor spindle to left until extractor tang is released.

(2) Remove extractor tang (fig. 7) through the loading hole in the breechblock. Push extractor spindle back into its seat and raise the curved end into the lug so that it will be out of the way.

(3) Release breechblock latch from latch catch by pushing in on operating handle plunger. Unscrew breechblock from breech recess by turning counterclockwise. It should be grasped firmly after unscrewing it six turns from closed position as it will drop out between the sixth and seventh turns. To protect it from the dirt, place breechblock on a bench or paulin before attempting further disassembly.

(4) Withdraw extractor spindle (fig. 7) and remove extractor.

(5) For views of component parts of breech mechanism see figure 8.

b. Breechblock.—(1) Remove safety piece assembly and firing pin (fig. 7) by drawing firing hammer to rear, pulling safety piece plunger knob outward, unscrewing safety piece.

(2) After the firing safety piece assembly and firing pin are removed, press firing hammer assembly as far as it will go into safety piece recess, remove firing hammer pin, then remove firing hammer.

(3) Remove lanyard from firing hammer link (fig. 7) by withdrawing it through eye of breechblock arm.

(4) Remove firing rack assembly, firing rack spring, and firing rack spring assembling pin by pushing operating handle plunger forward and pressing inward on head of pin with a screw driver.

One-fourth of a turn will disengage pin from slot in firing rack from which position it can be withdrawn.

(5) Remove breechblock latch assembly, breechblock latch spring, breechblock latch pin by turning it approximately one-quarter of a turn outward to disengage it from its retaining groove. Draw pin out of arm. Hold parts as spring forces them out. If spring does not come out force it by pushing pin through hole in breech face of breechblock arm.

(6) Remove operating handle plunger block, operating handle plunger and operating handle plunger screw by unscrewing latter and withdrawing parts. If plunger block does not come out force it by pushing breechblock latch pin through small hole in operating handle.

13. Removal of shields from carriage M1897, M1897MIA2, or M1897A4.—*a. To remove right shield.*—(1) Set carriage at 0° traverse. Remove thong and drive out apron latchkey (figs. 36 and 37) connecting shield staple and brake worm support. Disconnect shield brace by removing cotter pin and washer and withdrawing shield upper pin.

(2) If shield is seven-piece type, remove thong and drive out key connecting right and left shields.

(3) If shield is four-piece type remove nut and drive out bolt connecting the distance plate and the right shield, and swing distance plate out of the way. Remove thong and drive out key which holds apron in traveling position and swing apron down. Remove brake crank pin and pull off brake crank. Pull right side of shield to the front until shield staple is free of brake worm support. Pull shield to right and out of socket on trail side plate.

b. To remove left shield.—(1) Remove thong and drive out key connecting shield staple and left shield bracket.

(2) According to the type of shield, proceed as provided above. Pull left side of shield to front until shield staple is free from shield bracket, and pull shield to front.

14. Dismounting and mounting gun, carriage M1897, M1897MIA2, or M1897A4.—*a. Dismounting.*—(1) Provide means for supporting the gun while it is being removed in order to avoid damaging the upper roller path of the recoil mechanism by the front rollers.

(2) Set brake.

(3) Set gun at 0° elevation and see that it is in battery position.

(4) With breechblock removed, raise piston rod coupler key latch and withdraw piston rod coupler key (fig. 17) from right to left as far as it will go. In case it does not work freely, tap key lightly,

care being taken not to injure latch. Remove sweeper bolt pin and sweeper plate guide bolt, and withdraw sweeper plate.

(5) Push the gun to the rear, with pairs of men at opposite ends of three heavy timbers supporting the gun at either end and at the center.

b. Mounting.—Assemble in reverse order of dismounting.

15. Dismounting and mounting recoil mechanism, carriage M1897, M1897M1A2, or M1897A4.—*a. Dismounting.*—(1) Remove screws and sight shield.

(2) To remove range rack screw, raise rear of rocker by turning angle of site handwheel until segment rack of rocker and angle of site worm gear shaft pinion are out of mesh. Lift rear end of recoil mechanism as far as it will go. Remove cotter pin and elevating screw pin by turning handle of pin to about a horizontal position. This disengages the lug of the pin. Swing elevating screw toward rear, free of lugs of rocker, and unscrew from elevating nut. (If force is necessary to remove elevating screw, care must be taken not to damage walls of opening through the screw.)

(3) To remove range scale, turn elevating crank (fig. 15) until range scale reads zero. Drive out crank locking plate pin and pull elevating crank locking plate off yoke. The locking plate brings with it the elevating crank and crankshaft. Remove range scale shaft nut and range scale washer. Remove range scale.

(4) Open right and left trunnion caps by removing thongs and driving out keys. Tap rear end of oil hole housing until it is possible to pry the cap. Remove rocker arm caps by inserting a bronze drift into oil hole. Lift it out.

(5) Raise recoil mechanism clear of trunnion bearings and move it to rear and off carriage. Place mechanism on wood blocks.

b. Mounting.—Assemble in reverse order of dismounting.

16. Disconnecting and connecting brake frame to axle, carriages M1897 and M1897M1A2.—*a. To disconnect.*—(1) Release brake. Shoes should be far away from tires. Remove cotter pins from brake forks and brake fork keys. Pull up on keys and remove.

(2) The next step requires a man on each side of the trail. Each grasps a tie rod at end nearest brake beam and lifts it up as far as it will go. The man on right side of trail uses his left hand to hold tie rod, leaving his other free to turn brake latch pin which engages lug on seat support bracket. He turns latch pin to right and raises it as far as it will go and pulls backward on brake shaft lever. Drop brake frame on ground and pull backward.

b. To connect.—Assemble in reverse order of disconnection.

17. Removal and assembly of wheels, carriages M1897 and M1897MIA2.—*a. Removal.*—Jack up carriage until wheels are clear of the ground. Block up under front end of trail so as to prevent carriage from tipping or slipping. Withdraw thong from linchpin latch (fig. 10) and swing latch out until it is free. Pull out latch and linchpin. Pull off axle caps.

b. Assembly.—Assemble in reverse order of removal.

18. Removal and assembly of axle, carriages M1897 and M1897MIA2.—*a. Removal.*—Drive off left axle collar. Move axle to the left by means of traversing mechanism until right axle collar comes in contact with right axle bracket. Remove axle sleeve. (Should axle sleeve stick, traverse axle to the right when sleeve will remain in right axle bracket.) Traverse axle to the right until threads on axle and those in traversing nut are completely disengaged. Pull out axle to the right.

b. Assembly.—Assemble in reverse order of removal.

19. Disassembly of gun and carriage, M1897A4.—Disassembly of gun and carriage, with exception of the high speed adapter, is the same as that outlined for disassembly and assembly of the 75-mm gun and carriage, M1897 and M1897MIA2.

20. Disassembly and assembly of high speed adapter, carriage M1897A4.—*a. To remove disk and rim wheel.*—Wheels must be raised clear of the ground. Remove disk and rim wheel nuts (fig. 29) and then slip disk and rim wheel off.

b. To remove hub and brake drum assembly from spindle.—Remove hub cap and hub cap gasket. Remove cotter pin, nut, and wheel spindle outer washer from wheel spindle. Then slip hub and brake assembly off the wheel spindle.

c. To remove spindle bracket from axle.—First remove disk and rim wheel as in *a* above. The hub and brake drum assembly may also be removed as in *b* above, though this is not necessary. Disconnect radius rod from radius rod bolt stud. Remove seven hexagonal head cap screws which fasten brake shaft in left spindle bracket. Disconnect brake rods from brake shaft. Remove cotter pin and then remove linchpin assembly, axle cap, and high speed axle bracket outer shim if one is used. Spindle bracket may then be slipped off axle.

d. To remove wishbone.—Remove ball socket outer cap from rear end of wishbone, then remove axle clips clamping wishbone to axle. Wishbone is then free.

e. To remove seats.—Remove ball socket outer cap. Disconnect each radius rod at one end. Then upon removing bolts the compen-

sator shaft, compensator shaft support, brackets, and right and left seat and support assemblies can be removed from trail.

21. Dismounting and mounting gun, carriage M2A2.—a.
Dismounting.—(1) Provide means for supporting gun in a horizontal position while it is being removed in order to avoid damage to gun slides.

(2) With trail spread, place piece on the firing jack, or if left on its wheels, set brake. Depress gun until equilibrator assembling nuts (fig. 23) can be screwed on to equilibrator rod their full length. Elevate gun to 0° elevation and see that gun is completely in battery.

(3) Remove breechblock assembly. Raise piston rod coupler key latch and withdraw key. In case it does not work freely, tap key lightly, care being taken not to injure latch.

(4) Push back gun. When removing gun do not cramp it. Place gun upon wood blocks or some suitable rest.

b. Mounting.—(1) Reverse procedure of *a* above, then elevate and depress piece to be sure of ease of operation.

(2) Assemble breechblock. Lock gun to recoil mechanism by assembling piston rod coupler key.

(3) Depress gun and remove equilibrator assembling nuts (accessory) (fig. 23). Equilibrator trunnion pins must be seated properly in their bearings. Elevate and depress tipping parts to be sure of ease of operation.

22. Dismounting and mounting recoil mechanism, carriage M2A2.—a. *Dismounting.*—(1) Remove telescope mount and range quadrant. Proceed according to instructions outlined in paragraph 21a. With screw driver, loosen machine screw (fig. 22) in trunnion nut and remove nut. Remove machine screws in trunnion ball retainer. Remove bolts (fig. 27) in trunnion caps, and remove caps. Raise holding cradle and recoil mechanism sufficiently to slide retainer (fig. 22) trunnion bearing plate, outer, trunnion ball cup, trunnion ball, and trunnion ball spacer from holding cradle trunnions.

(2) In removing parts referred to care must be taken not to bur or bruise them. They should be cleaned and stored in a safe place until reassembled. Inner bearing plate, inner trunnion ball retainer, and trunnion bushing should not be removed.

(3) Lift holding cradle and recoil mechanism clear of top carriage trunnion bearings. Place mechanism on wood blocks.

NOTE—Each holding cradle and recoil mechanism is considered a unit and must be shipped and handled as such since location of studs which secure recoil mechanism to cradle are in a different position on each recoil mechanism.

b. Mounting.—(1) Lift holding cradle and recoil mechanism into position, trunnions of cradle being in line with trunnion bearings of top carriage, and with sufficient clearance to assemble the trunnions.

(2) Clean trunnion bushings (fig. 22) and coat them lightly with medium mineral lubricating grease. Assemble the following parts in the order given: Trunnion ball, trunnion ball cup, trunnion ball spacer, trunnion bearing plate, outer, and trunnion ball retainer, outer, coating each part with grease.

(3) Lower cradle and recoil mechanism into top carriage trunnion bearings. Assemble trunnion caps with bolts (fig. 27). Line up screw hole in trunnion ball retainers, inner (fig. 12) and outer, and trunnion bearing plates, inner and outer, trunnion caps and top carriage trunnion bearings, and assemble machine screws. Screw trunnion nuts on cradle trunnions and lock in position by tightening machine screws. Replace telescope mount and range quadrant.

23. Dismounting and mounting equibrator, carriage M2A2.—*a. Dismounting.*—(1) Place carriage in firing position. Depress gun until equibrator assembling nuts (accessory) (fig. 23) can be screwed on to equibrator rods their full length, using socket wrench.

(2) Elevate gun, then raise and withdraw equibrator through rear opening of top carriage.

NOTE.—The equibrator trunnion pin may be adjusted or removed by first releasing the equibrator trunnion pin lock. Further disassembly of the equibrator by the using arm is prohibited.

b. Mounting.—Elevate gun and insert ball portion of equibrator (fig. 23) into its seat. Assemble equibrator trunnion pin, making proper adjustment by screwing pin in or out. Depress gun until equibrator trunnion pin is properly seated. Assemble equibrator trunnion pin lock.

24. Disassembly of wheel hub from spindle, carriage M2A2.—Remove machine screws from hub cap. Remove cotter pin from wheel spindle. Remove slotted nut and disk and rim wheel spindle washer. When pulling hub from spindle be sure to protect roller bearing from falling to the ground.

25. Assembly of wheel, carriage M2A2.—*a.* If hub is removed from spindle the cavity of hub should be cleaned with dry-cleaning solvent and wiped dry. Fresh grease should be packed around roller bearings before assembly.

b. Slide hub over spindle, guiding cup of inner roller bearing over cone and rollers and brake drum. Slide outer cone and roller of bearings on spindles and guide them into their seats in roller bearing

cups. Assemble disk and rim wheel spindle washers, outer, and slotted nuts on spindles. Tighten nuts sufficiently to allow wheels to revolve freely without end play. Assemble cotter pins. Attach hub caps with machine screws.

SECTION IV

INSPECTION AND ADJUSTMENT

	Paragraph
Gun -----	26
Carriage -----	27
Sighting equipment -----	28

26. Gun.—The following instructions should be scrupulously observed:

Parts to be inspected in order

of inspection

Points to observe

a. Gun.

a. Note general appearance, smoothness of operation of breech mechanism in opening and closing, action of operating handle plunger and firing mechanism with lanyard. Note condition of bore for copper deposits on lands and in grooves, and erosion at origin of rifling. Examine breech recess for scored and bruised threads and leveling plates for burs or other defects. Examine gun slide bearings or rollers for burs, dents, cleanliness, proper lubrication, and rigidity of the assembly. The bronze slides of the M1897A4 gun should fit the rails tightly, but the rails should be able to move longitudinally from their anchor at the jacket support. Insure that barrel supports and jacket and muzzle hoops are tight. Examine safety bolt assembly for deformed lug and for condition of the spring.

b. Breech mechanism.

b. Disassemble and clean breech mechanism. Examine breechblock for any defects, also firing pin. Examine firing hammer and firing rack for burs or bruises. Test action of firing rack spring by pulling lanyard. Note striking force of firing hammer.

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*Parts to be inspected in order
of inspection**c. Extractor tang.
d. Extractor spindle.
e. Extractor.**f. Safety piece.**g. Firing pin.**h. Firing hammer.**i. Firing rack spring
assembling pin.**j. Firing rack.**k. Firing rack spring.**l. Breechblock latch pin.**m. Breechblock latch.**n. Breechblock latch
spring.**o. Operating handle
plunger screw.**p. Operating handle
block.**q. Operating handle
plunger.***27. Carriage.***a. Carriage.**b. Recoil mechanism.**Points to observe**c. Note deformation or breakage.**d. Note evidence of scoring or binding.**e. Check for broken lips, scoring or
binding.**f. Bruised threads or deformed ham-
mer stop screw.**g. Deformed point, protrusion.**h. Deformed gear teeth.**i. Deformed projections.**j. Condition of teeth and screw.**k. Weakness or breakage.**l. Binding or breakage.**m. Wear or breakage, worn pawl, weak
or broken pawl spring.**n. Weakness or breakage.**o. Condition of threads.**p. Worn or broken projections.**q. Condition of threads and scores on
exterior.**a. General appearance. Note condition
of carriage paint, and that all moving
parts are lubricated.**b. Release reserve oil in recuperator.
Note action of oil indicator and whether
it recedes. Replenish oil reserve and see
that oil indicator moves out as oil is
forced into recuperator. Examine front
end of recoil cylinder, filling and drain
plug hole, and oil index recess for leak-
age. Presence of a few drops of oil in
any of these places will in no way affect
the recoil mechanism. When any undue
leakage is present the use of the recoil
mechanism is prohibited. Return to ord-
nance personnel for repair.*

*Parts to be inspected in order
of inspection**c. Elevating mechanism.**d. Angle of site mech-
anism, carriages M1897,
M1897MIA2, and M1897-***A4.***e. Traversing mech-
ism.**f. Brake mechanism,
carriages M1897A2 and
M1897MIA2.**g. Shield.**h. Trail.**i. Wheels, steel-tired,
carriages M1897 and
M1897MIA2.**Points to observe**c. Elevate and depress the gun the full
extent of travel. Note binding or undue
backlash.**d. Elevate and depress rocker through
full extent of travel. Note any undue
binding or backlash.**e. Traverse carriage. Note smooth-
ness of operation, binding, or backlash.**f. See that brakes operate freely.**(1) Try the wheel brakes by jacking
up carriage and standing on a spoke.
Neither wheel should revolve.**(2) Lower brake mechanism to firing
position and test carriage as to whether
it may be traversed from extreme right
to left without opposition from brake
frame.**(3) Latch brake mechanism and test
latches.**g. Examine shield, and note whether
all keys, thongs, hinges, etc., are in serv-
iceable condition.**h. Loose rivets, nuts, and screws.**i. Test tightness by tapping lightly
with a hammer.**(1) Tightness of hub bolts.**(2) End play by grasping spokes and
moving wheel in and out.**(3) Remove wheel and note condition
of inner and outer washers. Note condi-
tion of hub liner, spindles, and exposed
parts of axle.**(4) Replace wheel and take up end
play; make certain that leather washer in
axle collar is not less than $\frac{1}{8}$ inch thick.**(5) Pull out on top and push in on
bottom of wheel. Hold wheel in this po-
sition and place a scale or straightedge
on shield with its end touching inner edge*

*Parts to be inspected in order
of inspection*

Points to observe

j. Brake mechanism, carriages M1897A4 and M2A2.

of top of tire. Then push in on top and pull out on bottom of wheel. The distance between end of scale and inner edge of the top of the tire represents the rock of the wheel on the axle. The maximum allowable rock is 0.281 ($\frac{1}{32}$) inch, representing an increase in diameter of hub liner of 0.06 inch. When hub liner is beyond this limit is must be replaced.

j. Test brakes by placing carriage in firing position, wheels clear of the ground. Set brake hand levers. Note position of brake ratchet pawl. If in last tooth of brake ratchet brake shoes should be adjusted. Release brake hand lever to "off" position. Note whether wheels revolve freely.

k. Trails, split (75-mm gun carriage M2A2).

k. Place carriage in position. Move trails to 45° position. Note that they swing freely. Examine trail connection. See that it locks the trails together without unnecessary strain.

(1) Test drawbar lock. Note whether drawbar lock shaft enters hole in drawbar arm without force.

(2) Examine all supports and fastenings.

l. Wheels and tires on carriages M1897A4 and M2A2.

l. Examine nuts. Note condition and whether they are set up tight. Note whether rim is deformed.

m. Wheel, disk and rim, with tire, assembly (75-mm gun carriages M1897A4 and M2A2).

m. Test wheels to see that they have proper toe-in of $\frac{1}{8}$ of an inch and revolve freely and that there is no wobble. If wheels wobble examine spindles to see that they are not bent. Examine wheels for warping. Examine tires to see whether crown of tire is taking the wear. If worn to left or right of crown test alignment of wheels.

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75-MM GUN MATERIEL, M1897, AND MODIFICATIONS 27-29

Parts to be inspected in order

of inspection

Points to observe

n. Traveling lock of M2A2 carriage. n. Examine for performance of its function.
o. Traversing rack of M2A2 carriage. o. Examine traversing rack for broken or deformed teeth.

28. Sighting equipment.

a. General.

a. Inspect for general appearance and lubrication. Note undue lost motion in operation of various gears. Check level vials to insure that they are tightly secured in their holders.

b. Telescope mount.

b. Insure that all parts are properly assembled and that various screws and studs are tight. Check the ease of operation for travel and for firing. Inspect alignment and if necessary adjust telescope mount. Check lubrication.

c. Panoramic telescope.

c. Check lubrication. Inspect alignment and if necessary adjust.

d. Range quadrant.

d. Check lubrication. Inspect alignment and if necessary adjust.

SECTION V

MALFUNCTIONS

Paragraph

Gun	29
Recoil mechanism	30

29. Gun.

Malfunction

Cause

Correction

a. No momentum of firing hammer. a. Broken firing rack spring. a. Replace.
b. Fails to fire until after several percussions on primer. b. Firing rack and hammer not working freely. b. Disassemble firing mechanism completely and examine all parts for burs or roughened surfaces. Remove burs or rough spots with fine file or oilstone. Wash all parts with dry-cleaning solvent. Dry thor-

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
		oughly and lubricate with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047.
	(1) Weak firing rack spring.	(1) Replace.
	(2) Deformed or broken firing pin point.	(2) Replace.
c. Fails to discharge; no percus- sion on primer.	c. (1) Safety piece not locked. (2) Breechblock not fully closed.	c. (1) Set safety piece plunger properly in breechblock arm. (2) Close breechblock.
d. Fails to extract cartridge case.	d. Broken extractor.	d. Ram the case out gently from the muzzle end. Examine edge of chamber for deformation or burs which might cause difficult extraction. Disassemble mechanism and replace extractor if necessary.
e. Pawl fails to operate.	e. Broken pawl spring or broken breechblock latch spring.	e. Disassemble breech mechanism until pawl can be removed. Examine springs and if latch spring is broken replace it. If pawl spring is broken, replace with new breechblock latch assembly.
f. Breechblock does not rotate freely.	f. (1) Lack of lubrication.	f. (1) Remove breechblock. Clean block thoroughly and recess with dry-cleaning solvent. Wipe thoroughly dry. Lubricate with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047, and assemble.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
	(2) Burs or roughness on threads of block and clean block breechblock or in breech recess.	(2) Remove breech block and recess as in (1). If burs or roughness are found, correction must be made by ordnance personnel.
g. Safety bolt can be pushed down by hand after piston rod coupler key is removed.	g. Broken spring. Weak spring or rod coupler key is in notch.	g. Replace with new safety bolt assembly or refer to ordnance personnel.
h. Safety bolt fails to rise.	h. Broken lug.	h. Replace safety bolt assembly.
i. Safety bolt does not remain in upper position when coupler key is withdrawn.	i. Weak or broken spring. Spring does not engage in notch.	i. Replace safety bolt assembly.

30. Recoil mechanism.

<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
a. Oil leaking into front of recoil cylinder.	a. Failure of piston packing or wear of cylinder wall.	a. Notify ordnance personnel.
b. Oil leaking into filling and draining plug recess.	b. Failure of filling and draining valve.	b. Notify ordnance personnel.
c. Oil leaking around oil index.	c. Failure of packing.	c. Notify ordnance personnel.
d. Oil index not functioning.	d. Index stuck.	d. Withdraw reserve oil and insert approximately one-half the capacity of the oil screw filler. Tap oil index lightly as oil is being added.
e. Failure of gun to return into battery.	e. Insufficient oil reserve.	e. Withdraw reserve oil; insert sufficient oil to bring oil index even with rear face of cylinder rear sealing plate.

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<i>Malfunction</i>	<i>Cause</i>	<i>Correction</i>
	(1) Low nitrogen gas pressure.	(1) Notify ordnance personnel.
	(2) Excessive friction.	(2) Notify ordnance personnel.
	(3) Damaged slides, piston rod, or piston.	(3) Notify ordnance personnel.
f. Return of gun into battery with a reserve oil shock.	f. (1) Too much air from recoil cylinder escaping too fast through respirator.	f. (1) Withdraw reserve oil. Insert sufficient oil to bring oil index even with rear face of cylinder rear sealing plate. (2) Adjust respirator to small air vent. If this fails to correct trouble, withdraw oil reserve as indicated in (1).

SECTION VI**CARE AND PRESERVATION**

	Paragraph
Gun	31
Carriage	32
Recoil mechanism	33
Recoil oil	34
High speed adapter	35
Brake mechanism, carriage M2A2	36
Lubrication instructions	37
Cleaners and abrasives	38
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Paint and related materials	40
Lubricants	41
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31. Gun.—*a. General.*—(1) It is important that whenever the rate of fire permits, the cannoneer look through the bore before each loading to ascertain whether or not particles of cartridge case, wadding, or unburned powder remain in the bore. Presence of such particles may cause damage to the piece. During night firing the sponge should be used between rounds.

(2) If enemy shell burst near the gun, be sure before firing that the gun has not been damaged to a dangerous degree. Damage of a serious nature should be reported to the ordnance officer.

(3) In cleaning after firing, wash bore with a solution of $\frac{1}{2}$ pound of soda ash or 1 pound of sal soda in 1 gallon of water. Use a piece of burlap or cleaning cloth around the metal end of the rammer staff for swabbing. When all powder fouling has been removed, swab bore with clear water and finally dry bore with a piece of clean burlap or cleaning cloth.

(4) Leveling plates should be protected. Tools or other articles will not be placed upon them. In case of injury repair must be made by ordnance personnel.

(5) In order to clean oil well, muzzle rollers, and covers, the roller side plates of the M1897 gun (fig. 5) should be removed. Remove them by unscrewing muzzle roller center screw.

(6) Slides of the M1897A4 gun (fig. 6) should be examined by pushing the gun to the rear until three-quarters of the bearing strips, left and right, are exposed. Burs or rough spots should be removed with a fine file. Wash the strips with dry-cleaning solvent and wipe dry. Coat the strips with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047, and push gun into battery. Periodically, the gun should be removed from the carriage in order to clean the entire length of the slides.

(7) Lubricating instructions are given in paragraph 37.

(8) When matériel is not in use covers must be used.

(9) When gun is not to be used for a considerable time the bore, breech mechanism, and bright and unpainted surfaces should be cleaned with dry-cleaning solvent and surfaces coated with rust-preventive compound.

b. Breech mechanism.—(1) Should be kept clean and parts well lubricated. When not in use disassemble periodically, especially for detection of rust. When in use disassemble frequently, clean and oil. It should be so cared for immediately after firing.

(2) In removing rust-preventive compound the greater part should be scraped off. That remaining should be removed with dry-cleaning solvent used on a rag or waste.

(3) A steel hammer must not be used directly on any part of the mechanism. A copper drift or a hardwood block should be interposed, or a copper hammer used.

(4) Vigilance must be exercised to detect any cutting or abrasions on the pressure side of the threads of breechblock and breech recess. If breechblock does not rotate smoothly or if it requires a greater effort than usual to operate, it should be disassembled and examined. Scoring or bruises on threads of breechblock or breech recess should be reported to ordnance personnel.

c. Firing mechanism.—(1) The parts require the same attention as the breech mechanism. Therefore, frequent disassembly for the purpose of cleaning and oiling is required.

(2) Fouling of the firing pin, or the use of a thicker oil than authorized will cause absorption of the energy of the firing rack spring and firing hammer and may result in misfire. This is especially true in cold weather.

(3) Wear in this mechanism is negligible. Deformation may be on the rear end of the firing pin. This wear may cause sticking in the safety piece. If the firing pin is examined after each firing, replacement can be anticipated.

32. Carriage.—*a.* Attention should be given to cleaning, lubrication, and loose or broken parts. Lubrication, with method and frequency of application, is covered in detail in paragraph 37.

b. Bearing surfaces, revolving parts, springs, gear teeth, brake mechanisms, screw threads, and exterior parts, must be clean and free from dirt. Special attention should be given to exposed gear teeth and bearing surfaces. In disassembling and assembling operations, precautions must be taken to prevent entrance of foreign matter.

c. (1) Wheels pertaining to the M1897 and M1897MIA2 carriages should be removed periodically for examination and cleaning of axle, axle collars and washers, axle caps and washers, linchpins, and hub boxes. Roughness due to scoring or cutting should be smoothed off.

(2) Nuts on hub bolts should be tightened frequently during the first year, and at least twice a year thereafter. Ends of bolts are lightly peened over. Wooden parts are made of seasoned material and hub bolts are properly tightened, but in time the wood dries and shrinks and the spokes become loose. If used in this condition wheels may become damaged, unfit for service. Wheels should not be soaked in water to tighten tires by expanding the wooden rims.

(3) Axle caps allow three adjustments before it is necessary to add washers. Leather washers should be placed between outer end of hub and axle cap so that after the linchpin is in place the wheel has only a slight longitudinal play. There should be at least one leather washer between hub and axle collar. Axle caps are notched, therefore effort should be made to obtain the above results with the deepest notch in axle caps. Reduce the longitudinal play by placing linchpins in shallow notches.

d. Carriage should be given a general inspection periodically.

e. Care and maintenance of the carriage require the use of the cleaning and preserving materials issued by the Ordnance Department.

f. When carriage is stored or is to remain unused for a considerable

length of time, all bright and unpainted surfaces should be protected with a coat of rust-preventive compound. Before applying the compound the surfaces should be cleaned with dry-cleaning solvent.

33. Recoil mechanism.—*a. Firing precautions.*—(1) Before firing, examine for leakage of oil, oil reserve, and see that front of recoil cylinder is clean. Holes in respirator must not be clogged. Slide and roller paths of the cradle must be clean and properly lubricated.

(2) During firing, action of the mechanism should be noted, and the following operations checked:

- (a) Gun recoils its prescribed distance.
- (b) Gun returns into battery without shock.
- (c) Leakage of oil from filling and drain hole, oil index recess, and front of recoil cylinder is not excessive.

b. Oil.—(1) *General.*—When carriages are to travel or to be used at drill, recoil mechanisms will be filled to create an excess reserve of oil as described in (3) (c) below. An excess reserve of oil has been found necessary due to contraction of the oil which permits the gun to slide to rear sufficiently to bring rollers on roller paths, thereby indenting them. Care should be taken to establish normal reserve before firing.

(2) *Leakage.*—The following should be examined for oil leakage: front of recoil cylinder, filling and drain plug hole, and oil index recess.

(3) *Reserve.*—Firing should not be undertaken with an excess or lack of reserve oil. The oil reserve is indicated by position of the oil index with reference to rear face of recuperator cylinder rear sealing plate, as follows:

- (a) None, indicator is well into recess.
- (b) Full, end of index is even with rear face of recuperator cylinder rear sealing plate.
- (c) Excess, index projects beyond rear face of cylinder rear sealing plate.

c. To reduce or exhaust oil reserve.—(1) Remove the filling and drain plug.

- (2) Screw in the filling and drain valve release.
- (3) Oil flows out through release.
- (4) Unscrew release as soon as indicator begins to recede. If it is desired to eliminate the reserve completely, wait until flow stops.

d. To replenish oil reserve.—(1) Use oil screw filler.

- (2) Inject oil, watch oil indicator, and stop injecting oil when indicator reaches rear face of recuperator cylinder rear sealing plate.

e. To attach oil screw filler.—(1) Remove filling and drain plug.

(2) Unscrew piston as far as possible. Unscrew nut. Remove cover from filler. Fill filler with oil to within 1 inch of top, holding finger over nozzle.

(3) Insert piston and tighten nut.

(4) Give a few turns to screw, holding nozzle upward so as to remove air. This is indicated when there are no bubbles.

(5) Screw filler into filling and drain plug hole. Care should be taken to hold the filler straight so as to engage the threads. Give a few turns to screw so as to force out any air.

(6) Screw in the piston of the filler.

(7) Watch oil index and stop injecting oil when it reaches the rear face of the recuperator cylinder rear sealing plate. About one-half the capacity of the oil screw filler is required.

NOTE.—Care must be taken to avoid breaking end of filler or damaging threads in filling and drain plug hole. Trouble is caused by attempting to operate the oil screw filler with one hand. In operating the filler the handle should be so that it projects an equal distance on either side of the screw, both hands being used. With this method of operation the filler can be operated successfully and without damage.

f. To remove oil screw filler.—(1) Unscrew filler.

(2) Empty and put on nozzle cover.

(3) Replace filling and drain plug.

g. Nonfunctioning of oil index.—(1) Sometimes the oil index does not register when oil is being injected. On this account an excessive amount of oil may be injected.

(2) An excessive amount of oil is dangerous as during recoil the control rod will jam. This will damage or may cause destruction of the recoil mechanism.

(3) If the oil index does not move in when oil is being extracted or if it does not move out when oil is being injected, it is probable that the packing around the oil index is too tight. On the other hand the index may be broken or frozen.

(4) In order to test the oil index, by means of the filling and drain valve release, drain all the oil that will run out. After removing filling and drain valve release, inject oil by means of the oil screw filler. While injecting oil, tap index lightly on each turn of the oil screw filler. If index does not move out after about half the capacity of the oil screw filler has been injected, it is an indication that there is something wrong with the mechanism and the ordnance officer should be notified. If index works properly after the operation described the reserve oil supply should be injected and drained off about three times to insure that index is in working condition.

h. Use of recoil mechanism in emergency.—In an emergency it may become necessary or desirable to fire the gun without reference to the action of the oil index. The procedure is to assemble filling and drain valve release and extract all reserve oil. Refill mechanism with one and one-half fills of the oil screw filler. Remove oil screw filler and assemble filling and drain plug. Firing may then proceed until gun returns into battery with shock. Shock indicates that heat has expanded reserve oil and that some of it should be released. If mechanism is losing oil through leakage around packing, firing may continue until gun does not return into battery position.

i. General care.—All nonbearing surfaces should be kept painted. Bearing surfaces must be clean and lubricated. The felt wipers attached to the sweeper plate of the M1897 and M1897MI guns should be kept in good order and well lubricated.

34. Recoil oil.—*a. General.*—(1) The recoil mechanisms use heavy recoil oil with low pour point. Care must be taken not to use oil other than that prescribed.

(2) (a) Water or air must not be introduced into recoil mechanisms.

(b) Exposure of recoil oil in an open can may result in accumulation of moisture. Condensation in a container partly filled with oil, or pouring from one container to another which has moisture on its inner walls results in moisture being carried along with the oil into recoil mechanisms.

(c) It is advisable that recoil oil be tested for water. Use a clean glass bottle of a pint capacity filled with recoil oil. Oil should be allowed to settle. If water is present, the water being heavier than the oil, the water will sink to the bottom. With the bottle slightly tilted, drops or bubbles will form in the lower portion. Invert the bottle and hold to the light. Drops or bubbles of water if present may be seen slowly sinking in the oil. If the oil has a cloudy appearance the cloudiness may be ascribed to particles of water. Another test is to heat a shallow pan of oil to boiling. Water in the oil will appear on the surface as minute bubbles. This test will disclose water not determinable by the settling test.

(d) If either of these tests shows water, the oil on hand should be turned in.

b. Care.—(1) Transfer of recoil oil to a container not marked with the name of the oil may result in wrong oil getting into recoil mechanisms or in use of recoil oil for lubricating purposes. Recoil oil must not be put into container not marked with name of the oil.

(2) The following should also be observed:

(a) Recoil oils should not be left in open containers nor subjected to excessive heat.

(b) Greatest care must be taken with recoil oils to exclude moisture and dirt.

(c) Strain through clean cloth before inserting in recoil mechanism.

(d) Do not mix recoil oils with any other type of oil.

35. High speed adapter.—*a.* (1) As brake linings wear, it is necessary to adjust brakes in order that brake linings may come in contact with brake drums. Adjustment is made by the brake adjusting wedge being turned to the right one or two notches. After adjustment, wheel should revolve without drag.

(2) Carriage should be jacked up periodically and wheels revolved. Wheels should turn freely with no excessive side play. To determine side play, grasp sides of tire and shake wheel back and forth. If there is excessive side play remove hub cap and cotter pin from spindle and tighten spindle nut until side play is removed. Reassemble cotter pin and hub cap.

b. Carriage should not be moved any great distance with tires partially inflated, as side walls are unduly bent and fabric is subjected to stresses which cause rim cutting. Test tires daily. Those on the M1897A4 carriage should be inflated to 25 pounds pressure, and those on the M2A2 carriage should be inflated to 30 pounds pressure.

c. Screws, bolts, and nuts should be tested once a week and set up tight. Lock washers should be examined and replaced if necessary.

d. (1) Grease fittings of the adapter should be washed and cleaned in dry-cleaning solvent at least semiannually; also when the carriage has had hard usage. Grease should be injected once a month into all bearings.

(2) Wishbone should be lowered from the axle collars once a year and then raised to see that it has maintained its alignment with the grooves in the axle collars.

(3) Ball socket inner and outer caps should be removed periodically and examined for defects. Compensator ball stud spring should be replaced if found to be weak or rusted.

(4) Radius rod group should be disassembled periodically and cleaned to remove foreign matter that may have collected. When reassembling the parts should be lubricated.

(5) Wheels, hubs, and brake drums should be removed after every 1,000 miles. All grease should be removed from hub cavities, and hub and inner and outer roller bearings washed with dry-cleaning

solvent. When assembling, ball bearings must be packed with wheel bearing grease.

36. Brake mechanism, carriage M2A2.—*a.* Functioning of the brake is of vital importance. A freely operating brake insures a longer period of operation before readjustment becomes necessary.

b. Brake adjustment is accomplished by rotating the brake shoe adjusting wedge (fig. 35) in the desired direction. The wedge extends to the outside of the brake housing plate. The end of the adjusting wedge on which a wrench may be used is square.

c. (1) Procedure for adjusting brakes is—

(a) Set hand brake lever at full released position.

(b) Jack up wheel.

(c) Adjust brake adjusting wedge until a drag is felt on wheel. Back off just enough so that there is no drag. Brakes must be cold when making this adjustment.

(2) Position of hand brake lever and toe of brake shoe can be adjusted as follows:

(a) Remove disk-and-rim wheel hub and brake drum.

(b) Loosen locking nut at bottom of hand brake lever.

(c) Drive out brake cam shaft sufficiently to permit its splined section to rotate free of brake lever.

(d) Rotate brake cam the desired amount in the same direction it moves when brakes are applied to force the shoes upward, and replace cam in its operating position.

(e) Tighten brake lever locking nut, and reassemble disk-and-rim wheel hub.

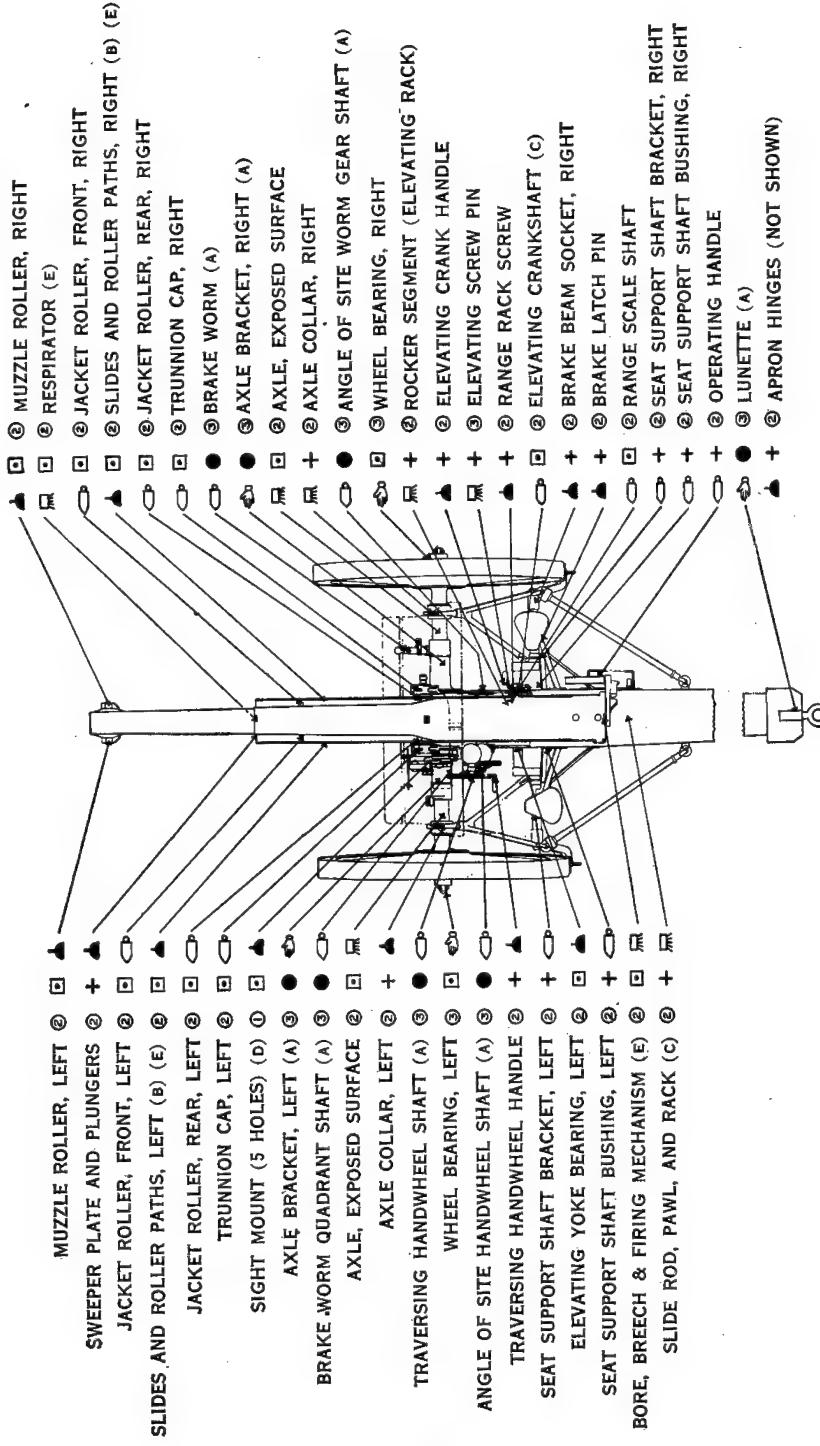
d. Wheel bearings should be adjusted to prevent drag.

e. Brake cam and rollers are lubricated through fittings. Lubrication must be correct to avoid the brake lining becoming saturated. Over lubrication will cause heavy brake handle pressure and may make necessary replacement of brake linings. Linings may be cleaned with dry-cleaning solvent.

37. Lubrication instructions.—*a.* Excessive wear can be prevented by keeping matériel clean and well lubricated. The life of gun and carriage depends on proper lubrication. Particular attention should be given to sliding and bearing surfaces such as inclined planes on gun and cradle and roller paths, roller bearings, and breech mechanism.

b. Lubricating oils and greases as shown in lubrication charts must be used as prescribed.

c. The lubrication charts shown in figures 1 to 4, inclusive, are provided for information and guidance.

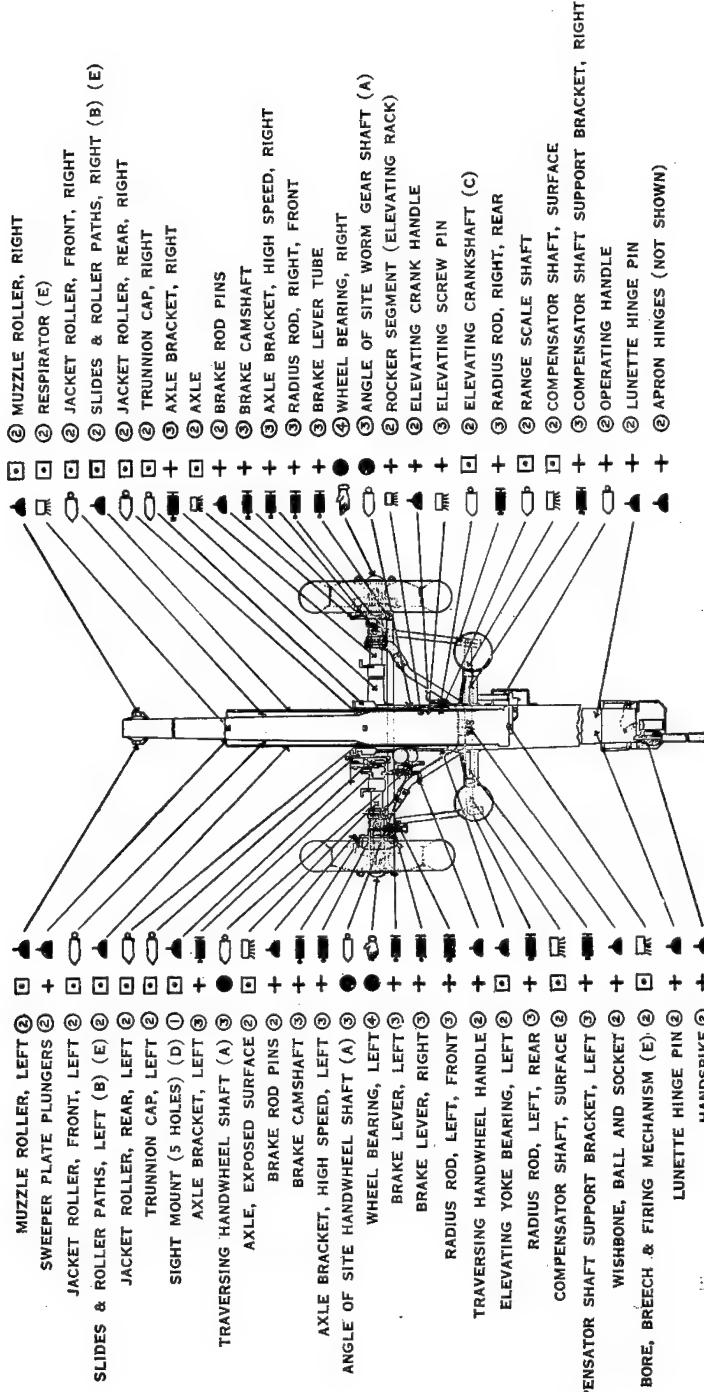


NOTES:

- (A) PACKED BY ORDNANCE AT ANNUAL OVERHAUL.
- (B) USE BRUSH WHEN BARREL IS RETRACTED.
- (C) PARTIALLY LUBRICATED BY SEEPAGE FROM RECOIL MECHANISM.
- (D) LUBRICATING OIL MAY BE USED IF NEUTRAL OIL IS NOT AVAILABLE.
- (E) LUBRICATE BEARING PARTS FREQUENTLY DURING FIRING. CLEAN AND LUBRICATE ALL PARTS IMMEDIATELY AFTER FIRING.

LUBRICANTS	HOW APPLIED	WHEN APPLIED		
		<input checked="" type="checkbox"/> DAILY, WHEN IN CONSTANT SERVICE, OTHERWISE WEEKLY.	<input type="checkbox"/> WEEKLY, WHEN IN CONSTANT SERVICE, OTHERWISE TWICE MONTHLY.	<input type="checkbox"/> EVERY SIX MONTHS.
① NEUTRAL OIL	OILER			
② LUBRICATING OIL—LIGHT (SAE 20) IN COLD WEATHER; HEAVY (SAE 50) IN HOT WEATHER	OIL GUN BRUSH OR CLOTH HAND PACKING			
③ MINERAL LUBRICATING GREASE				

FIGURE 1.—Lubrication chart, 75-mm gun and carriage, M1887.

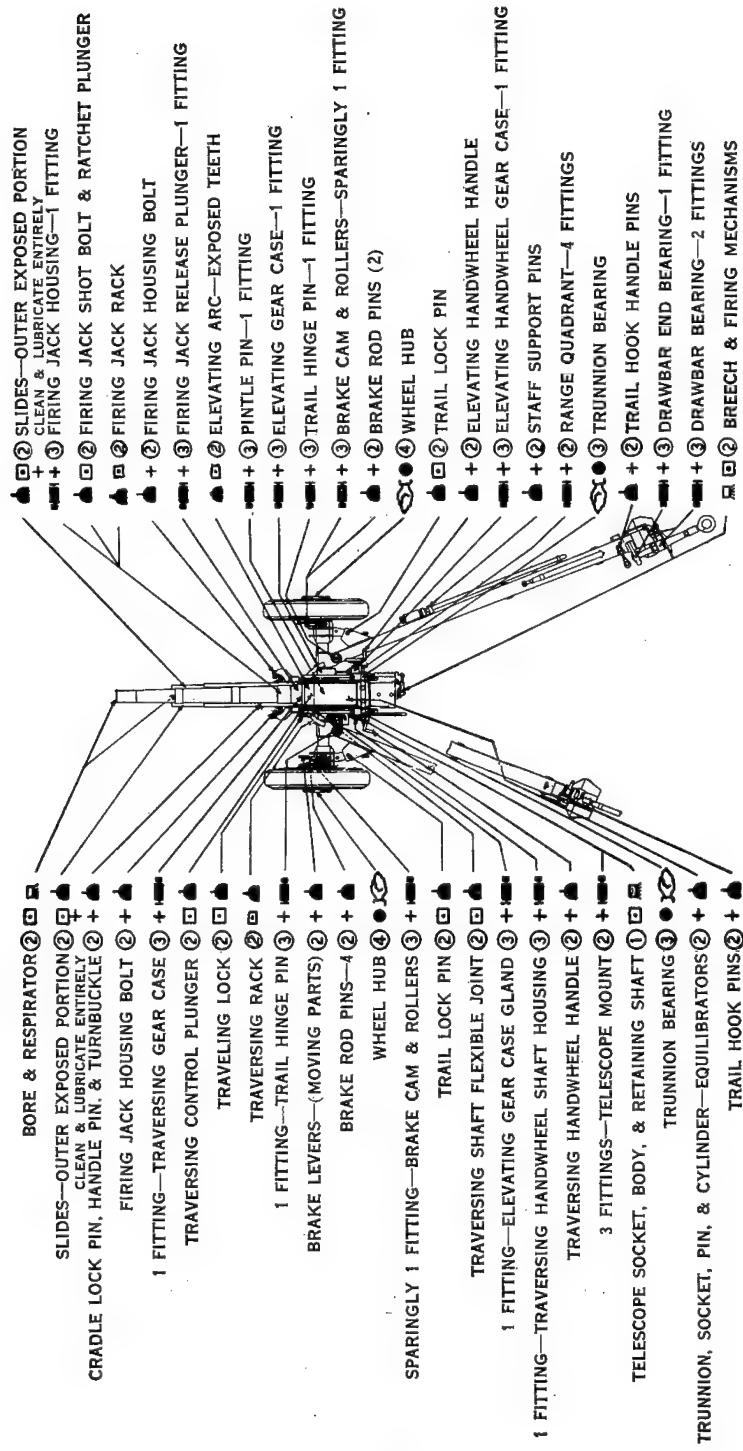


NOTES:

- (A) -PACKED BY ORDNANCE AT ANNUAL OVERHAUL.
- (B) -USE BRUSH WHEN BARREL IS RETRACTED.
- (C) -PARTIALLY LUBRICATED BY SEEPAGE FROM RECOIL MECHANISM.
- (D) -LUBRICATING OIL MAY BE USED IF NEUTRAL OIL IS NOT AVAILABLE.
- (E) -LUBRICATE BEARING PARTS FREQUENTLY DURING FIRING. CLEAN AND LUBRICATE ALL PARTS AFTER FIRING.

LUBRICANTS	HOW APPLIED	WHEN APPLIED
① NEUTRAL OIL	 OILER	<input checked="" type="checkbox"/> DAILY, WHEN IN CONSTANT SERVICE, OTHERWISE WEEKLY
② LUBRICATING OIL—LIGHT (SAE 20) IN COLD WEATHER; HEAVY (SAE 50) IN HOT WEATHER	 OIL GUN	<input type="checkbox"/> + EVERY TWO WEEKS
③ MINERAL LUBRICATING GREASE	 GREASE GUN	<input checked="" type="checkbox"/> ● EVERY SIX MONTHS
④ WHEEL BEARING GREASE	 BRUSH OR CLOTH  HAND PACKING	

FIGURE 2.—Lubrication chart, 75-mm gun and carriage, M1897A4.



LUBRICANTS	HOW APPLIED	WHEN APPLIED
① NEUTRAL OIL	OILER	<input checked="" type="checkbox"/> DAILY DURING CONSTANT USE, OTHERWISE EVERY TWO WEEKS
② LUBRICATING OIL—USE LIGHT (SAE 20) WHEN TEMPERATURE IS BELOW 50° F. OR (SAE 50) FOR TEMPERATURE ABOVE 50° F.	PRESSURE LUBRICATION GUN + EVERY TWO WEEKS	<input type="checkbox"/> + EVERY TWO WEEKS
③ MINERAL LUBRICATING GREASE	BRUSH OR CLOTH	<input checked="" type="checkbox"/> ● EVERY SIX MONTHS
④ WHEEL BEARING GREASE	BY HAND APPLICATION	

NOTE.—BEFORE FIRING AND DURING LUULLS, CLEAN AND OIL BEARING SURFACES OF BREECH AND FIRING MECHANISMS, AND SLIDES. AFTER FIRING, CLEAN AND LUBRICATE BORE, BREECH, AND FIRING MECHANISMS, SLIDES, AND ALL OTHER EXPOSED AND UNPAINTED SURFACES. WHEEL BEARINGS SHOULD BE REPACKED AFTER IMMERSION IN WATER.

FIGURE 3.—Lubrication chart, 75-mm gun and carriage, M2A1.

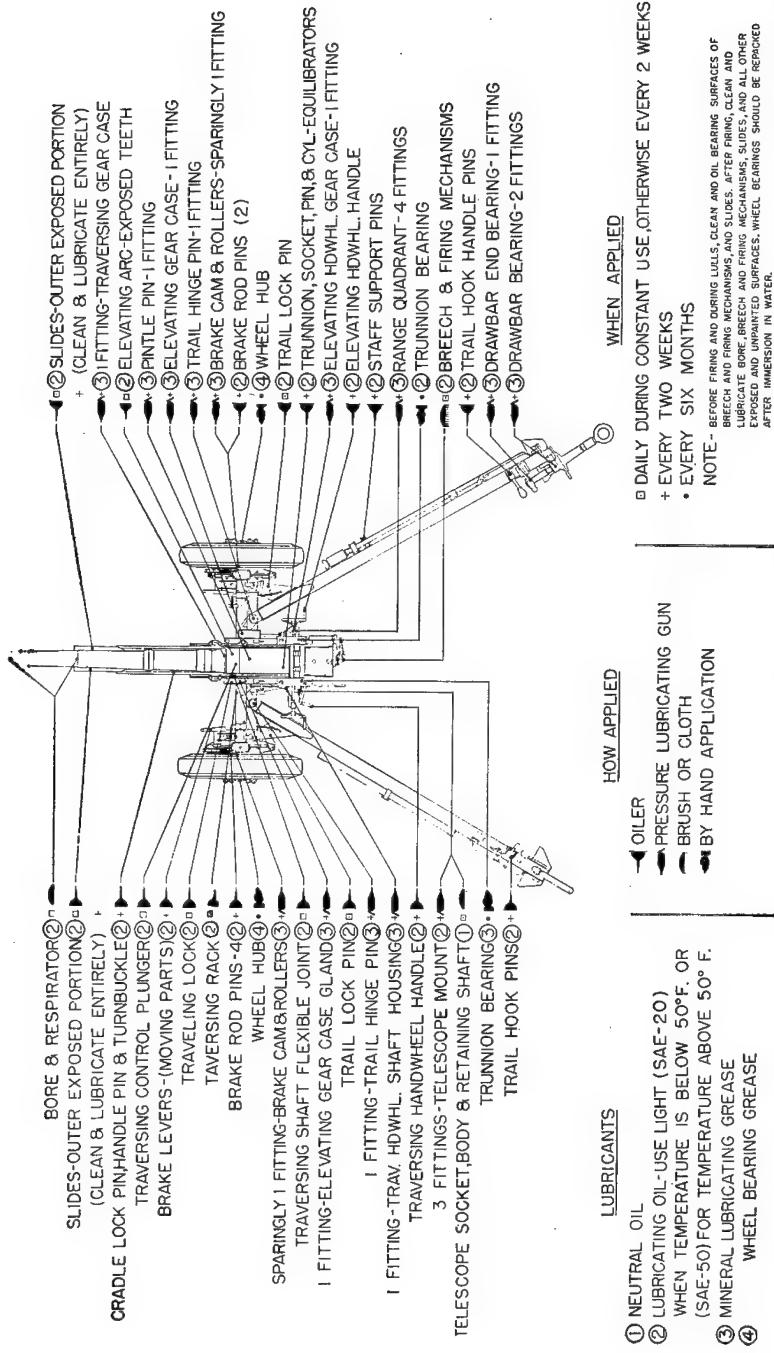


FIGURE 4.—Lubrication chart, 75-mm gun and carriage, M2A3.

38. Cleaners and abrasives.—See *TM 9-850 for those prescribed, their application, and use. The following are prescribed:

Burlap, jute, 8-ounce, 40 inches wide.
Cloth, crocus.
Cloth, emery, No. 00, No. 0, and No. 1.
Cloths, wiping, cotton, mixed, sterilized (for machinery).
Compound, cleaning.
Lime, hydrated (lime slaked and powdered).
Paper for cleaning optical glass.
Paper, flint.
Polish, metal, paste.
Remover, paint and varnish.
Soap, castile.
Soda, ash.
Soda, caustic (lye) for cleaning purposes.
Solvent, dry-cleaning.
Sponges.
Waste, cotton (two grades, colored and white).

a. Soap, castile.—(1) Used for cleaning leather equipment and as a component of saddle soap.

(2) Action of soap depends upon a chemical combination of alkalies in the soap and the grease which is to be softened and removed. The resulting soapy compound is readily washed off, leaving nothing to hold the dirt. The soap will thus remove some of the oil in the leather. Repeated washings will probably require replacement of oil to prevent the leather from becoming harsh and brittle.

(3) Nearly all ordnance leather equipment is russet leather. When it becomes soiled it should be cleaned by carefully removing all hardened grease with a sliver of wood (not glass or knife) and washing with a sponge saturated with a heavy lather of castile soap and clean tepid water. Rinse thoroughly and rub vigorously with a dry cloth until the leather is dry. Straps and other articles of unvarnished harness leather which become dry and brittle should be cleaned as described, and while the leather is still slightly moist given an exceedingly light coat of neat's-foot oil by rubbing with a soft cloth moistened (not saturated) with the oil. Wipe off any oil that the leather does not absorb. In cold weather the oil may be heated luke warm (never hot) and the article after being oiled hung in a warm place. Shellacked sole leather cases do not require oiling.

(4) Russet leather as manufactured is stuffed with a dubbing of cod-liver oil and tallow which is absorbed to the extent that the

*See Appendix.

quality of the leather is improved and its life prolonged, but not enough oil remains on the surface to soil the clothing if the equipment is properly cared for. It should be noted that in the washing and oiling described above if more than a light coat of oil is given, the leather will be greatly darkened and will quickly soil the clothing. No method of cleaning will then restore the original light color of the leather or remove stains from it.

(5) Articles of black leather may be cleaned with castile soap, rinsed, and when nearly dry, lightly sponged with a mixture of one teaspoonful of lampblack in 1 pint of neat's-foot oil, the mixture having been first stirred until it has a glossy black appearance. The mixture should then be well rubbed into the leather. Leather equipment which has become wet should be dried in the shade. Wet leather exposed to the sun or to too high a temperature from a stove or radiator becomes hard and brittle.

b. *Sponges*.—Used for washing and cleaning matériel. Natural sponges may be substituted by cellulose sponges in sizes Nos. 4, 6, 8, and 10 (approximate dimensions $1\frac{1}{4}$ by $3\frac{1}{8}$ by $4\frac{5}{8}$; $1\frac{5}{8}$ by $3\frac{1}{2}$ by $5\frac{1}{4}$; 2 by $3\frac{7}{8}$ by $6\frac{1}{4}$; $2\frac{1}{2}$ by $4\frac{5}{8}$ by $6\frac{1}{2}$). These latter sponges must not be wrung. Squeezing only is the proper method.

c. *Waste, cotton (two grades, colored and white)*.—(1) The colored cotton waste is used for general cleaning purposes on the exteriors of ordnance matériel such as gun carriages and automotive vehicles. It is also used as calking for cracks from which it is desired to exclude dust and dirt.

(2) White waste is used for general cleaning purposes on finished surfaces of ordnance matériel. In lieu of white cotton waste an equivalent amount of clean wiping cloths may be used.

39. Preservatives.—See *TM 9-850 for information on rust, corrosion, inspection for corrosion, rust preventives, preparation of metal surfaces for slushing, method slushing, inspection of grease films, and storage conditions.

a. *Naphthalene, flake*.—(1) A flaked form of moth ball.

(2) Used as a moth repellent to preserve felt wads, felt packings of instrument chests, gun sponges, and paint and varnish brushes. It is sprinkled thickly on the articles, which should if possible be then wrapped in paper covers and tightly boxed. The matériel should be thoroughly brushed and aired before packing and should be periodically inspected. If there are any signs of devastation by the moth larvae the articles must be unpacked, cleaned, and recharged with naphthalene.

*See Appendix.

b. Naphthalene should be used in airtight receptacles in order to obtain a concentrated naphthalene vapor.

40. Paint and related materials.

Lacquer.

Lead.

Lead, red, dry.

Lead, white, basic carbonate (or basic sulphate), paste.

Mixture, liquid (for red lead paint).

Oil, linseed, raw.

Enamel, red, water-resistant.

Enamel, synthetic olive-drab, lusterless.

Enamel, white.

Putty (whiting).

Stencil, black.

Stencil, white.

Shellac, orange.

Thinner (for olive-drab lusterless enamel).

Turpentine.

Varnish, shellac, orange.

Varnish, spar, water-resistant.

a. Oil paints and their application.—(1) Paint is used for preservation against rust, deterioration, and decay of metals and woods. Some paints adhere to metal surfaces better than others, the liquids of the first or base coat seeming to penetrate very minute depressions or pits in the metal or to etch themselves into the surface and thus form a good bond for following coats. The paints are issued mixed and ready to apply except in a few instances. Paint stored in large containers should be well stirred before transfer to smaller containers. Ordnance matériel is well painted before issue and one maintenance coat per year should be ample for protection.

(2) Red lead paint is a good base coat on iron or steel. Red lead possesses no particular advantages as a base coat on nonferrous metals. Red lead paint does not keep well and must be mixed as needed. The formula for 1 gallon of it is 20 pounds of dry red lead with 3 quarts of liquid mixture. The usual process of mixture is to place a small amount of dry red lead in a suitable container, work a little of the mixture into it to form a paste, and then stir the rest of the liquid mixture into it.

(3) The standard olive-drab lusterless synthetic enamel, QM Spec. ES No. 474b is issued mixed for a finishing coat. This enamel may be applied over long oil enamel or oil paint. Method of application may be by brush or spray. It may be brushed on satisfactorily when

used unthinned in the original package consistency; or when thinned no more than 5 percent of the volume with thinner, QM Spec. ES No. 370a. The enamel will spray satisfactorily when thinned with 15 percent by volume of thinner, QM Spec. ES No. 370a. If sprayed, it dries hard enough for repainting within $\frac{1}{2}$ hour. It dries hard in 16 hours. Linseed oil must not be used as a thinner for this enamel.

(4) For use on woodwork a sanding filler over the primer is required. The sanding filler is a ready-mixed semipaste but when thinned with 50 percent turpentine by volume has good brushing, covering, and leveling qualities. These fillers dry in approximately 8 hours.

(5) Care must be used in preparing the surface for painting. It should be made thoroughly clean, dry, and smooth.

(6) All paint should be well stirred before using. If too thick, turpentine should be used as a thinner, but not to such an extent that the paint does not cover. The exact and proper thickness of each coat can be learned only by experience. If too thin, it often cracks in drying, and if too thick it becomes blistered, wrinkled, and unequal. The first coat may however be much thinner than any of the succeeding coats.

(7) Parts to be painted may be washed in a liquid solution of $\frac{1}{2}$ pound of soda ash in 8 quarts of warm water, then rinsed in clean water, and wiped thoroughly dry.

(8) When artillery is in fair condition and only marred in spots, the marred places should be touched with enamel or paint and permitted to dry. The whole surface should then be sandpapered with No. 1 flint paper and repainted with a finish coat and allowed to dry thoroughly before use.

(9) When matériel is in bad condition, all parts should be thoroughly sandpapered with No. 2 flint paper, given a coat of enamel or olive-drab second-coat paint, and permitted to dry. It should then be sandpapered with No. 00 flint paper. Finally apply a finishing coat and permit the parts to dry thoroughly before used.

(10) After repeated paintings the paint may become so thick as to scale off in places or present an unsightly appearance. It may then be removed by use of a lime-and-lye solution on metal parts, or paint and varnish remover, or cleaning compound on wood parts. It is important that every trace of lye, remover, or cleaning compound be rinsed off. In addition to the cleaning, woodwork should be properly putty-stopped after priming coat and before second coat is applied.

(11) Oil cups, grease gun fittings, spring oil hole covers, and similar lubricating devices as well as a spot $\frac{3}{4}$ inch in diameter around each oil hole are painted red so that they may be readily located.

(12) At the conclusion of a painting job, the brushes must be carefully washed clean with dry-cleaning solvent and kept in water, except that camel's-hair brushes, after thorough cleaning, should be laid flat on a shelf or other convenient, clean surface in order that the hair may not be distorted. Worn paint brushes should be retained for use in spreading rust-preventive compounds. Any usable paint remaining in the paint pot should be kept tightly covered.

b. Lacquer.—A rapidly drying and very transparent liquid. Sets to touch in 3 minutes. Used on sandblasted metal surfaces of fire-control and sighting equipment because of its transparency and to prevent tarnishing and deterioration. The lacquer, which must be thin enough to flow easily, is applied with a camel's-hair brush. Alcohol may be used as a thinner but only when absolutely necessary.

c. Lead.—(1) *White, basic sulphate or carbonate, paste.*—Used as an extra heavy rust-preventive coating on exposed metallic surfaces. Various materials have been used to reduce the stiff lead paste to a more plastic and workable material. Since freedom from corrosive elements is desired rust-preventive compound is preferable to lubrication oil for this purpose. Melted tallow is sometimes used. The white lead coating may be used for preservation of matériel in stand-by condition, the idea being that it is more adhesive under extremes of temperature than rust-preventive compound. It should not be used on intricate working surfaces where it cannot be readily removed without damaging those surfaces.

(2) *Red, dry.*—(a) Separate requisition is required for the necessary liquid mixture for making red lead paint.

(b) Red lead paint is used as a base coat on iron and steel non-bearing parts of ordnance matériel. It has the effect of slightly etching the surface and so secures a good bond for succeeding coats.

d. Mixture, liquid, for red lead paint.—Used for mixing red lead paint.

e. Oil, linseed, raw.—Used as an auxiliary thinner for ready-mixed paint. As a thinner add small quantities of the raw oil at a time, stirring constantly until the paint flows freely under the brush.

f. Enamel, red, water-resisting.—Used around oil holes and fittings for lubricants to attract attention and furnish ready identification. Also for target marking disks and aiming posts.

g. Enamel, white.—Used on aiming posts.

h. Enamel, synthetic olive-drab, lusterless.—Used for painting all types of ordnance matériel unless otherwise specifically excepted.

i. Stencil, black.—Used for stenciling equipment and matériel, except on black background.

j. Stencil, white.—Used for stenciling equipment, and matériel, except on white background.

k. Shellac, orange.—Used for finishing inside of wooden chests.

41. Lubricants.

Oil, lubricating, SAE 20, Navy symbol 3050 or 1047.

Oil, lubricating, SAE 50, Navy symbol 3100 or 1100.

Grease, lubricating, mineral, medium grade, Federal Specification VV-G-681.

Grease, wheel bearing (regular grade).

Lubricant, chassis (summer or winter grade).

Oil, neutral, U. S. Army Specification 2-81.

a. Oil, lubricating, SAE 20, Navy symbol 3050 or 1047.—Used when temperature is below 50° F., on 56-inch wheels, gun slides, breech-blocks, etc., of artillery.

b. Oil lubricating, SAE 50, Navy symbol 3100 or 1100.—Used when temperature is 50° F. or above, on 56-inch wheels, gun slides, breech-blocks, etc., of artillery and, unless otherwise prescribed, for general lubricating purposes in summer weather.

c. Grease, lubricating, mineral, medium grade (or lubricant, chassis summer or winter grade).—Used in compression grease cups, pressure lubricating fittings, and gear cases which are not sealed. In hot climates the medium grade grease may be found to be too light, and the hard grade more suitable. Usually it is applied with a grease gun.

d. Grease, wheel bearing (regular grade).—Required for bearings of all artillery carriages incorporating in their design antifriction bearings.

e. Oil, neutral.—Used to lubricate delicate bearings of fire-control and sighting instruments when the temperature is above 32° F. unless otherwise prescribed. It is applied by dropping from the end of the dropper attached to stopper of the bottle, or from the end of a piece of clean wire.

f. Oil, lubricating, for aircraft instruments and machine guns (U. S. Army Specification 2-27).—Used to lubricate delicate bearings of fire-control and sighting instruments when the temperature is below 32° F. unless otherwise prescribed. It is applied by dropping from the end of the dropper attached to stopper of the bottle, or from the end of a piece of clean wire.

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g. In oiling fire-control instruments, only a few drops are needed. If more than necessary is used, it may run into the optical elements of the instrument and so affect the serviceability of the instrument as to require complete disassembly to remove the oil.

42. Miscellaneous materials and tools.—For the purposes for which used, see *TM 9-850. Articles are—

Brushes:

Mottling, No. 2 ($\frac{7}{8}$ inch).
Artist's, camel's-hair, round, No. 1 ($\frac{1}{8}$ inch).
Artist's, camel's-hair, round, No. 5 ($\frac{1}{4}$ inch).
Duster, painter's, round ($2\frac{1}{2}$ inches).
Sash tool, oval, No. 1 ($2\frac{7}{32}$ by $1\frac{3}{4}$ inches).
Sash tool, oval, No. 3 ($1\frac{3}{32}$ by $2\frac{1}{8}$ inches).
Scratch, painter's, handled (14 by $\frac{7}{8}$ inches).
Varnish, oval ($1\frac{7}{8}$ inches).

Knife, putty.

Needle, sacking.

Palm, sailmaker's.

Twine, jute.

NOTE.—*Care of brushes.*—Bristles of brushes are subject to attack by moths. Brushes in storage should be protected by naphthalene.

*See Appendix.

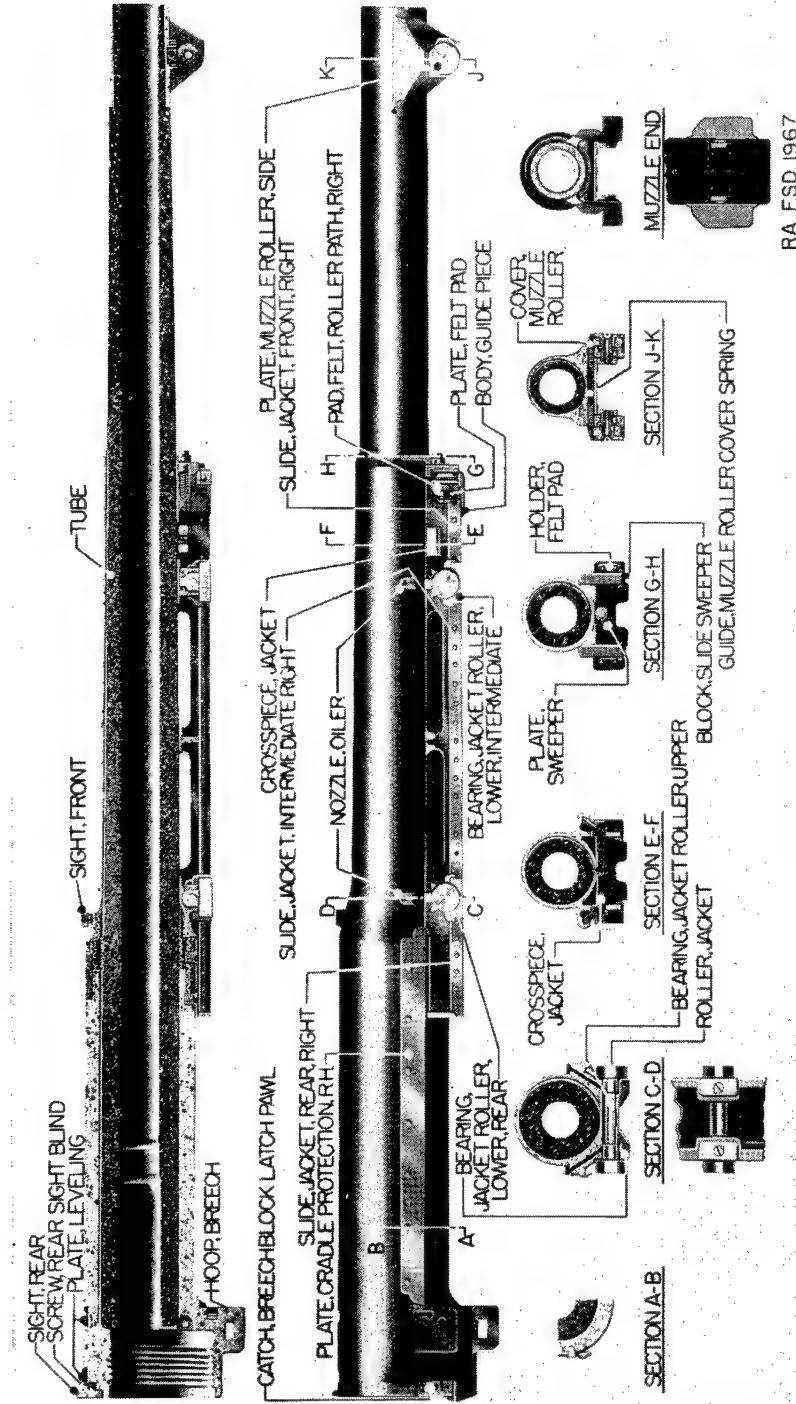


FIGURE 5.—Sectional view, 75-mm gun, M1897.

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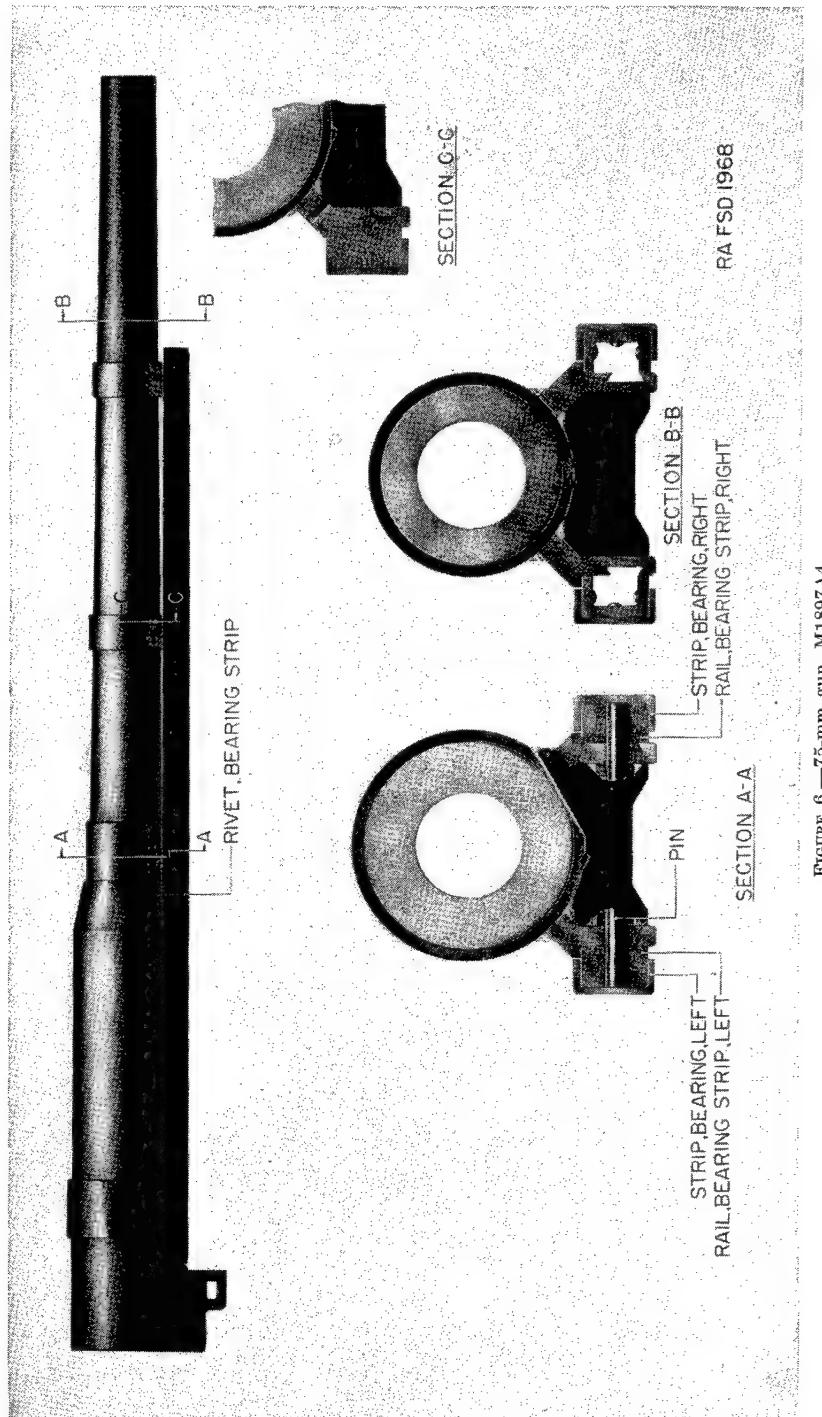


FIGURE 6.—75-mm gun, M1897A4.

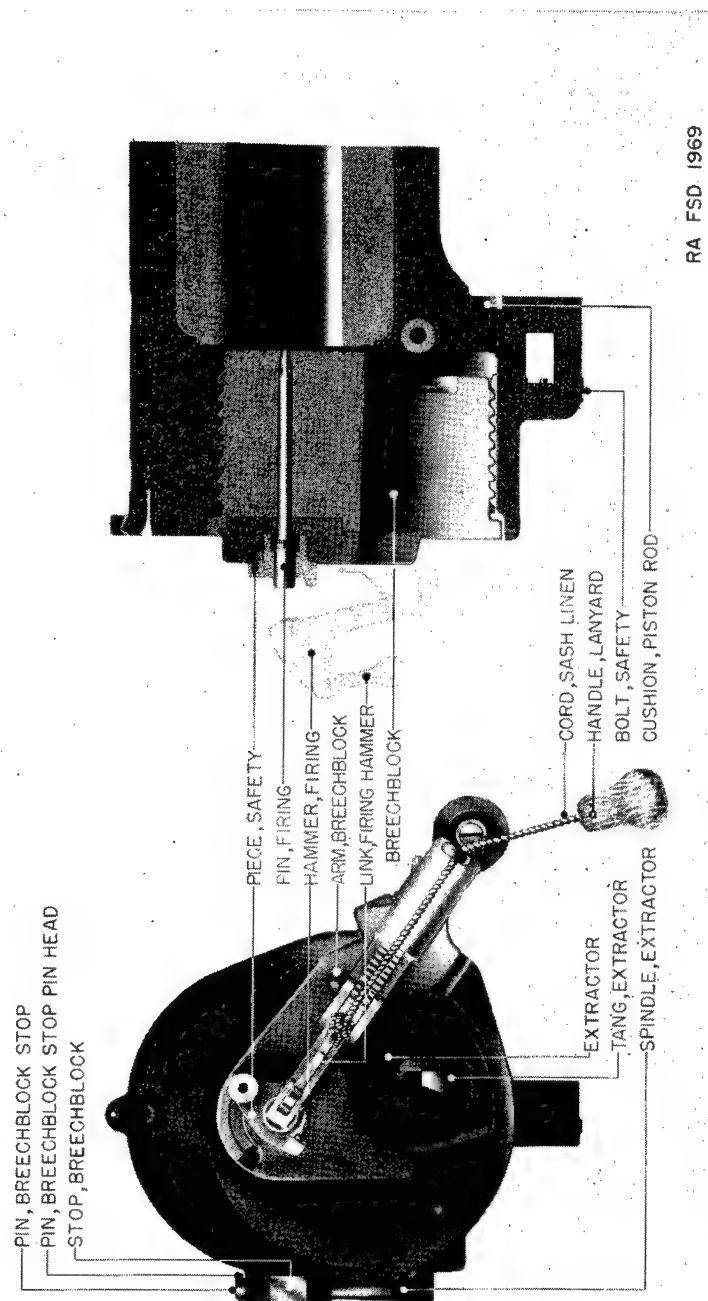


FIGURE 7.—Breech mechanism assembly and sections.

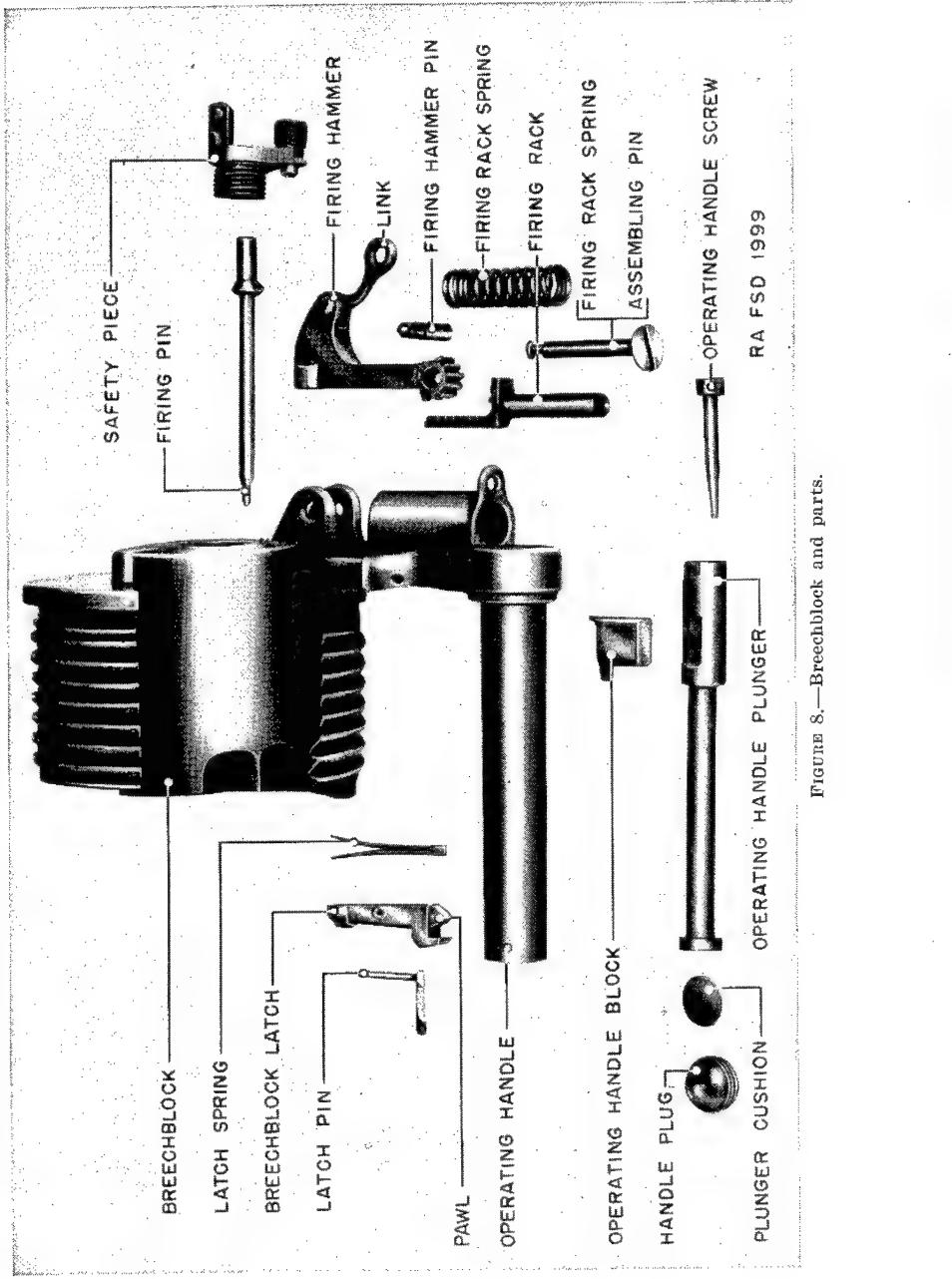


FIGURE 8.—Breechblock and parts.

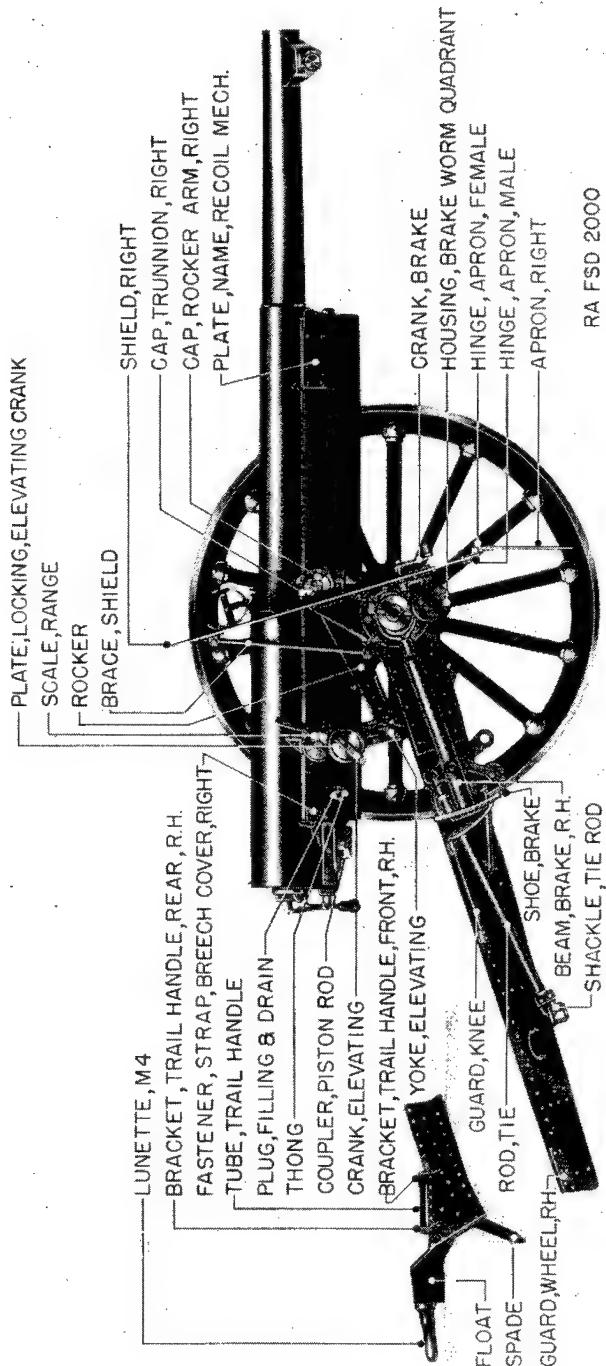
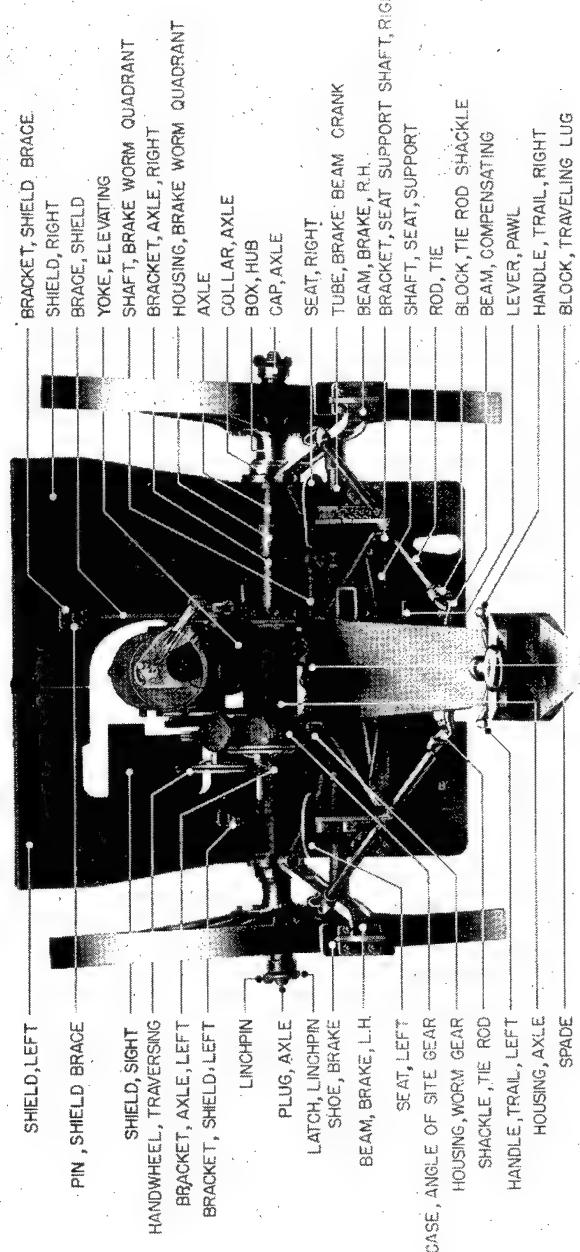


FIGURE 9.—75-mm gun carriage, M1897, right side.

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FIGURE 10.—75-mm gun carriage, M1897MI, rear view.

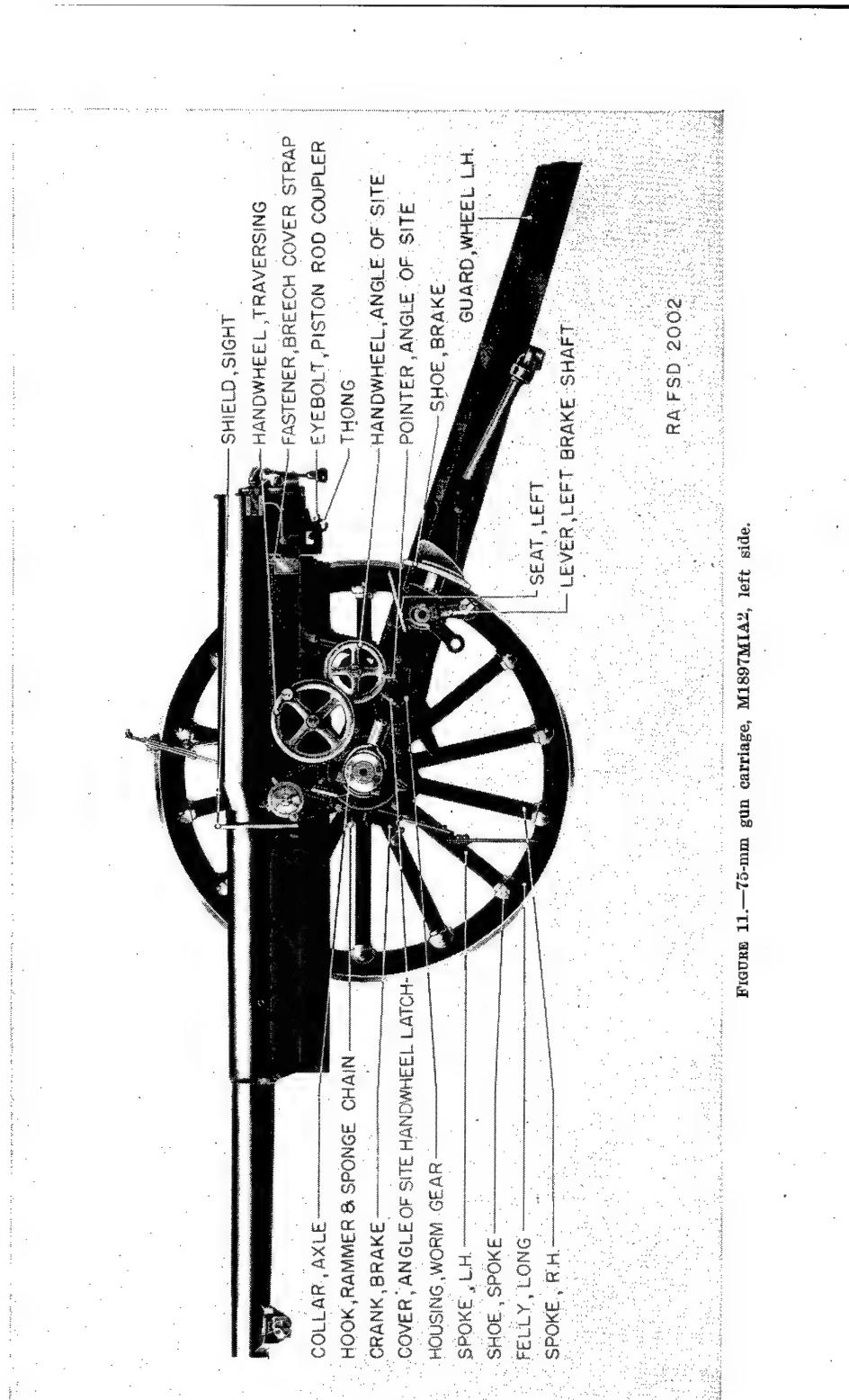


FIGURE 11.—75-mm gun carriage, M1897M1A2, left side.

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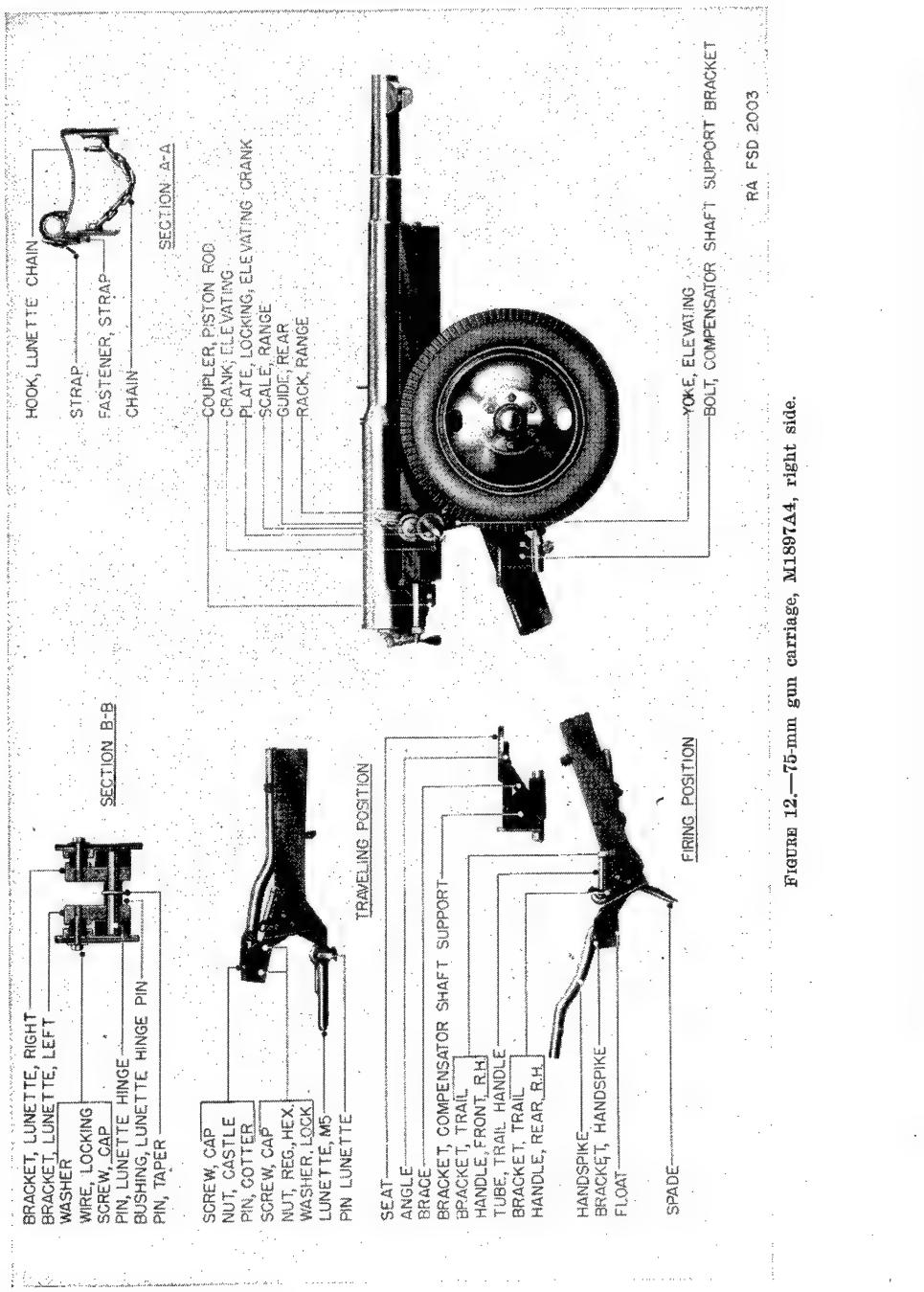


FIGURE 12.—75-mm gun carriage, M1897A4, right side.

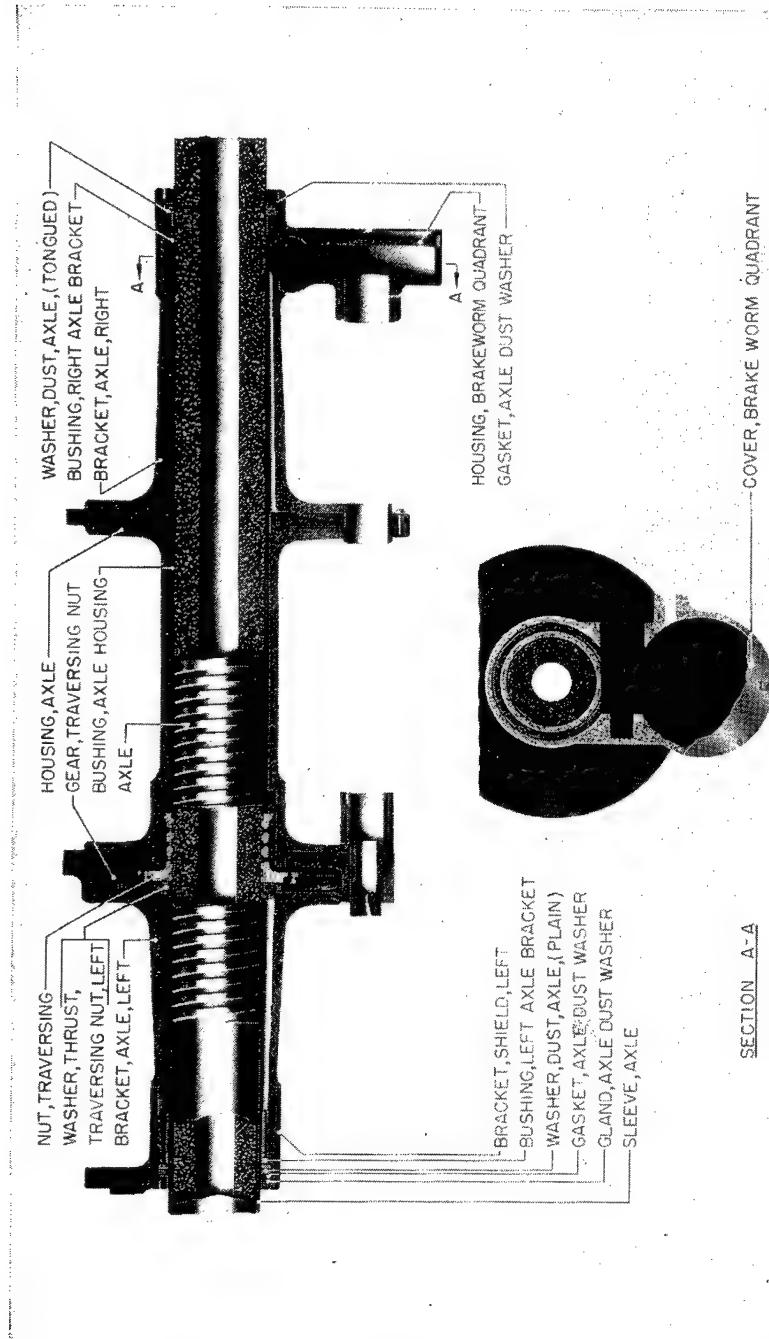


FIGURE 18.—Traversing mechanism, M1897A4, assembled views.

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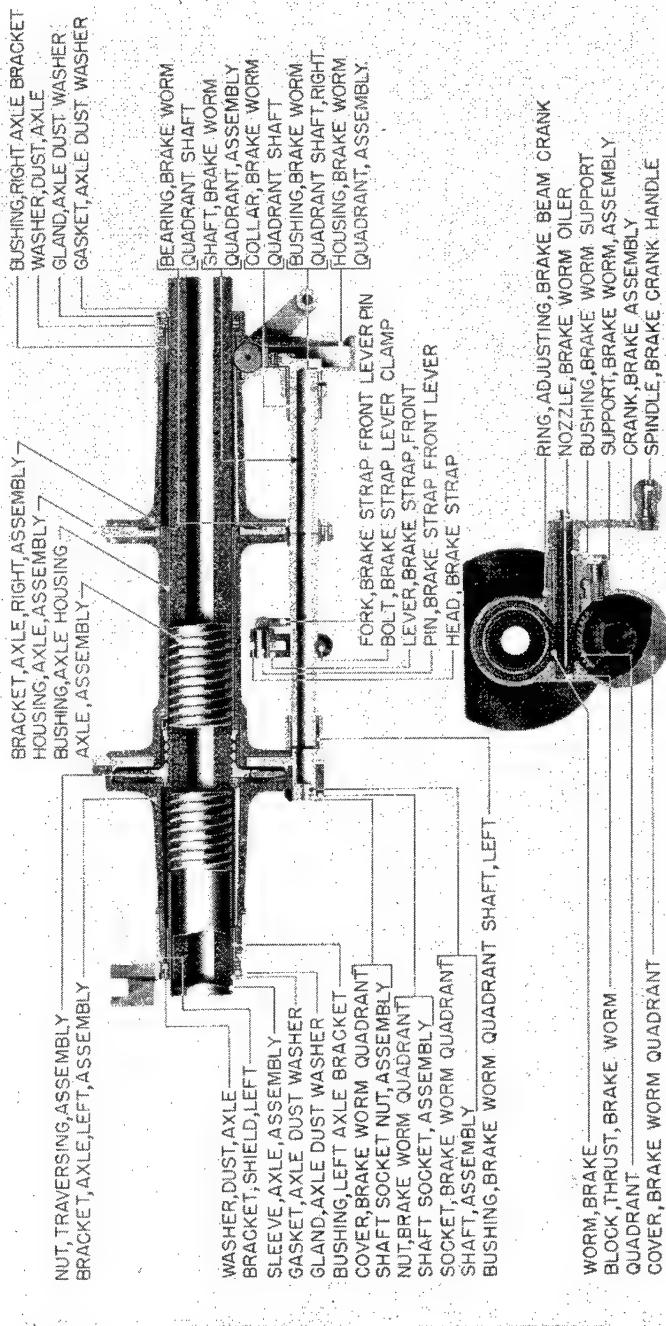


FIGURE 14.—Traversing and brake operating mechanism, M1897M12, assembled views.

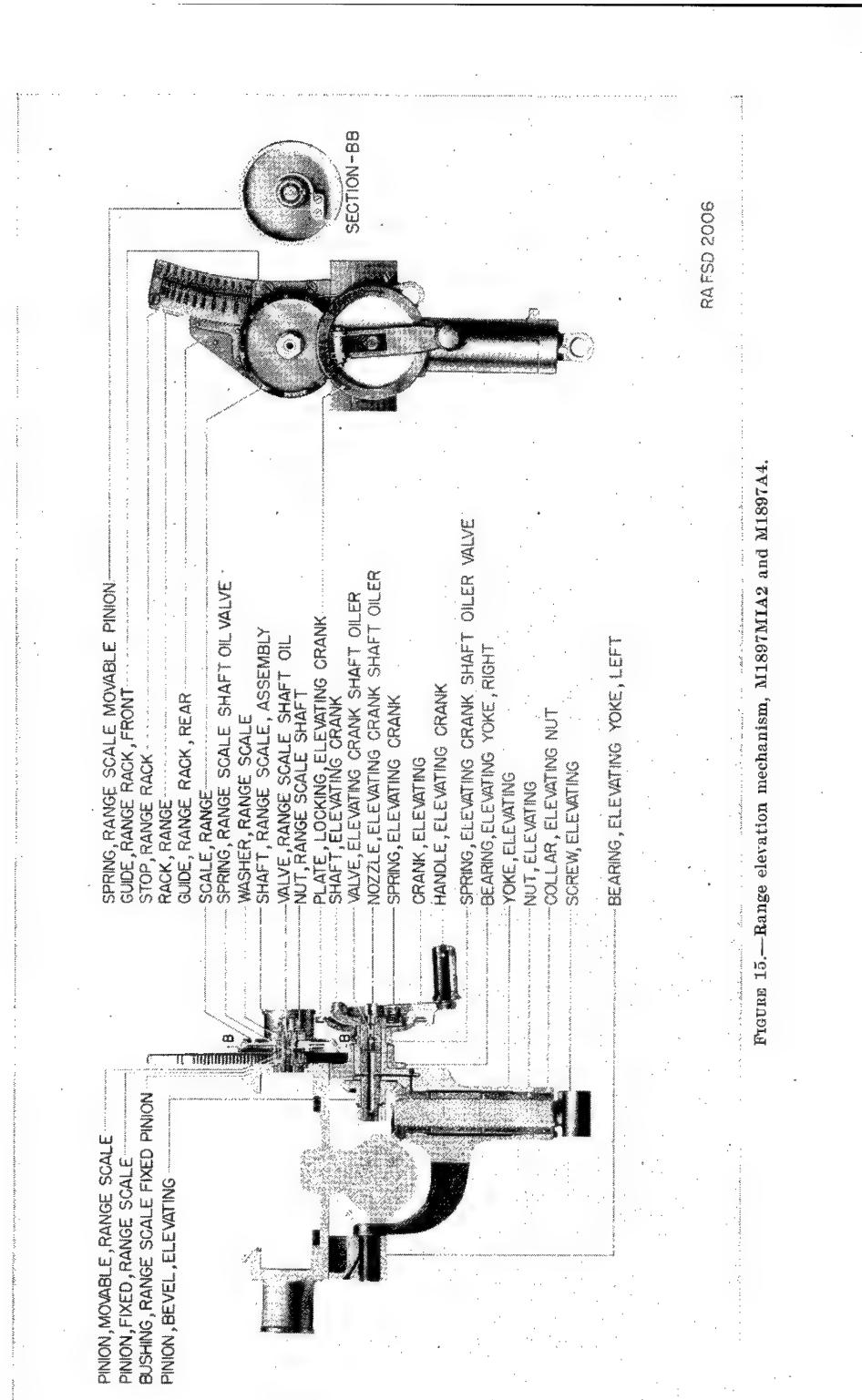


FIGURE 15.—Range elevation mechanism, M1897MIA2 and M1897A4.

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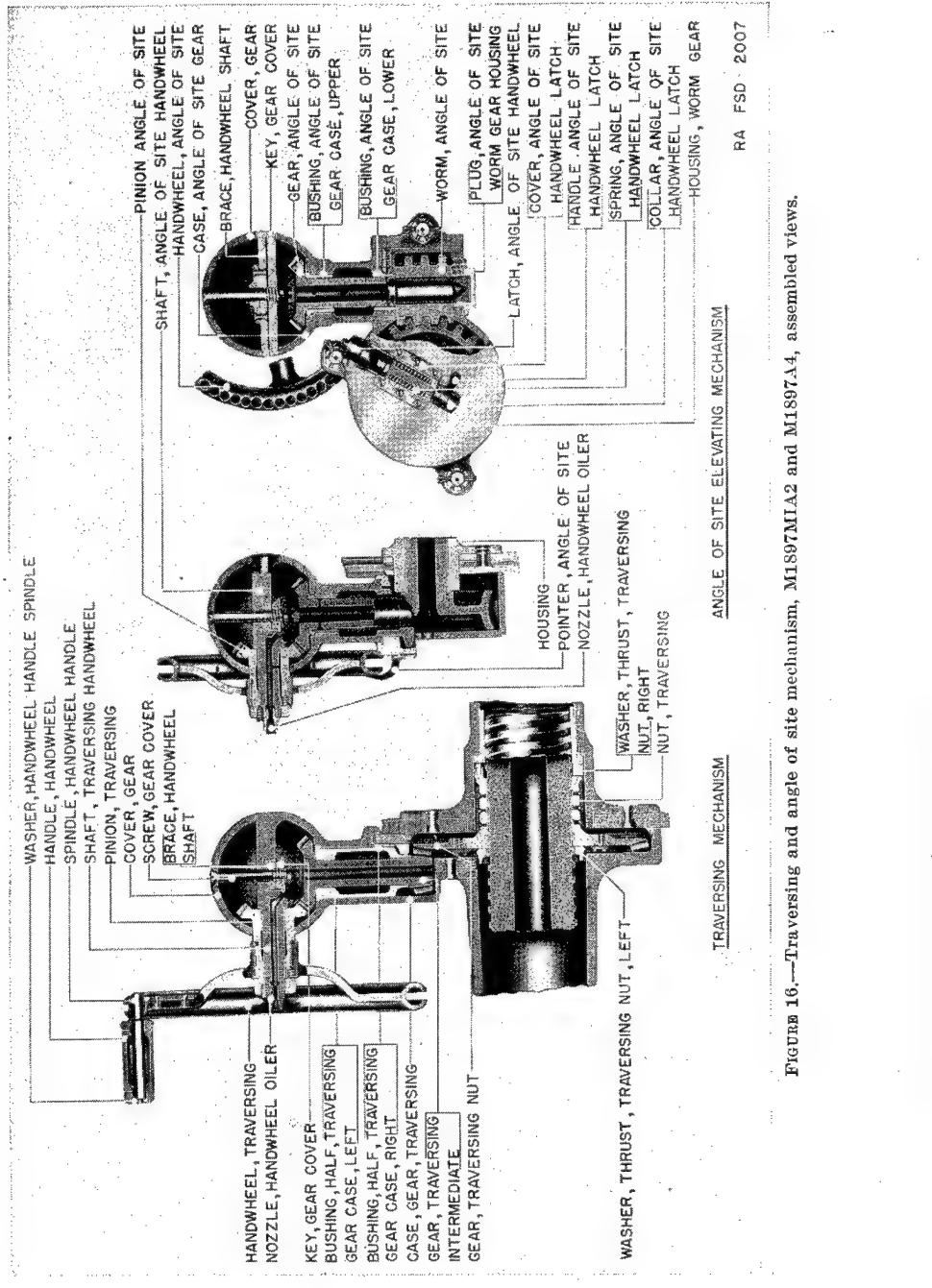


FIGURE 16.—Traversing and angle of site mechanism, M1897MIA2 and M1897A4, assembled views.

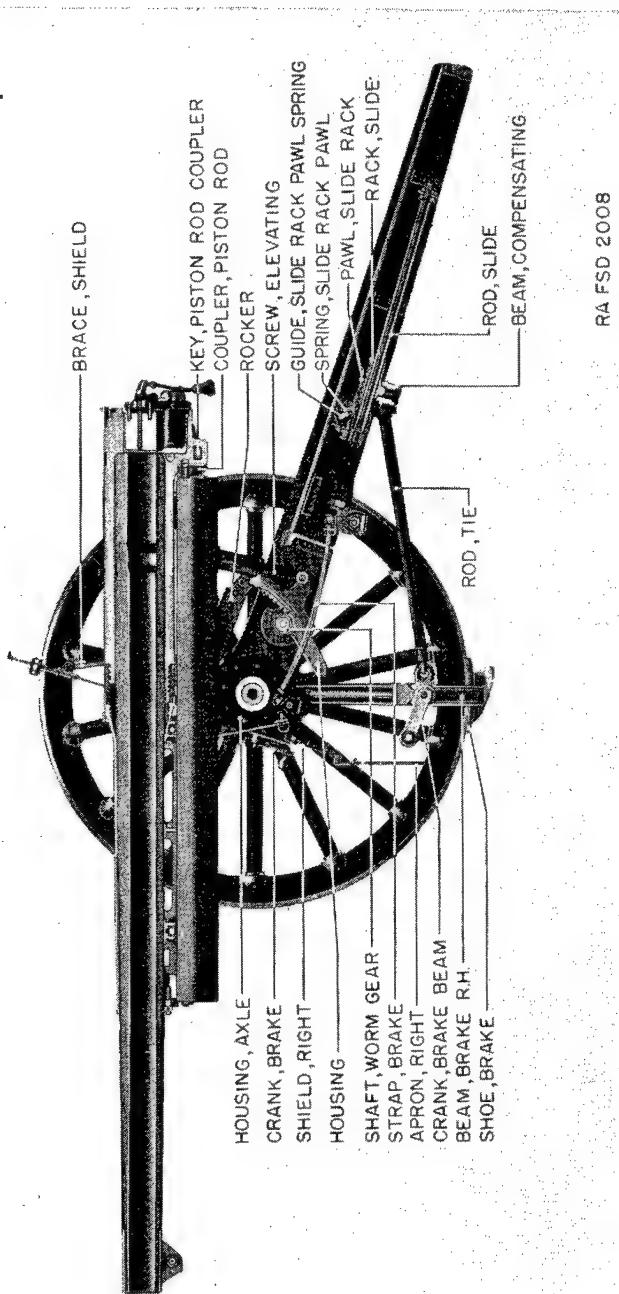


FIGURE 17.—Longitudinal section, 75-mm gun carriage, M1897MI.

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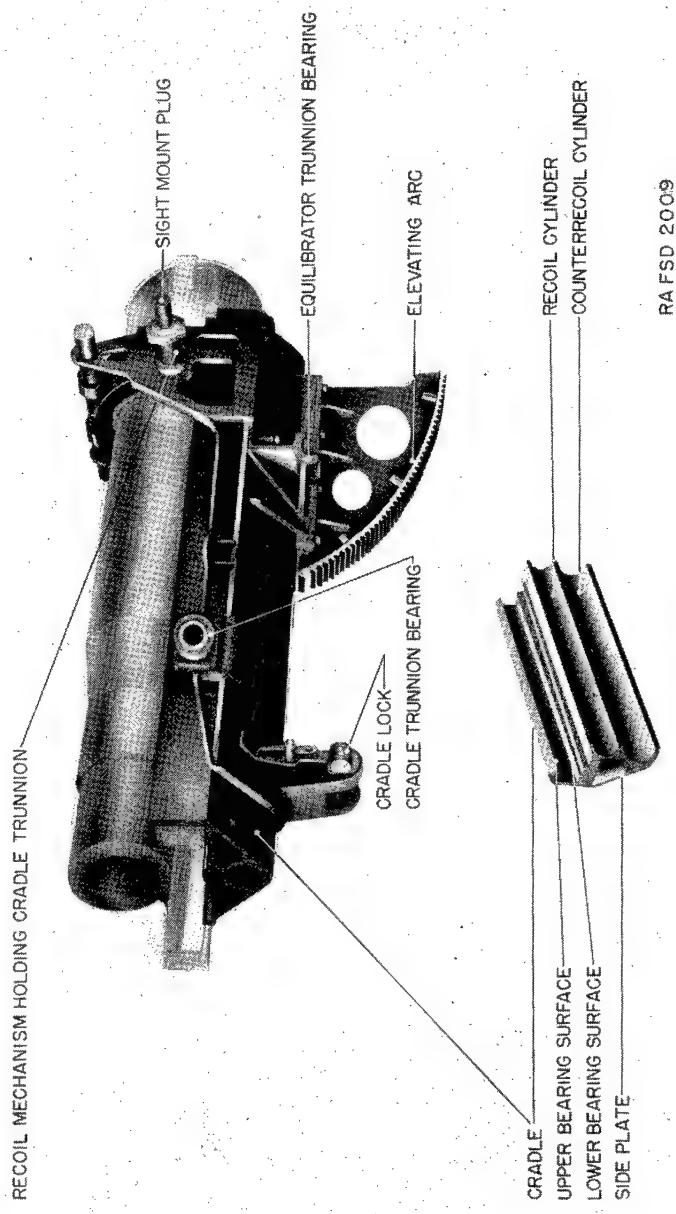


FIGURE 18.—Cradle and recoil holding mechanism, M2A2.

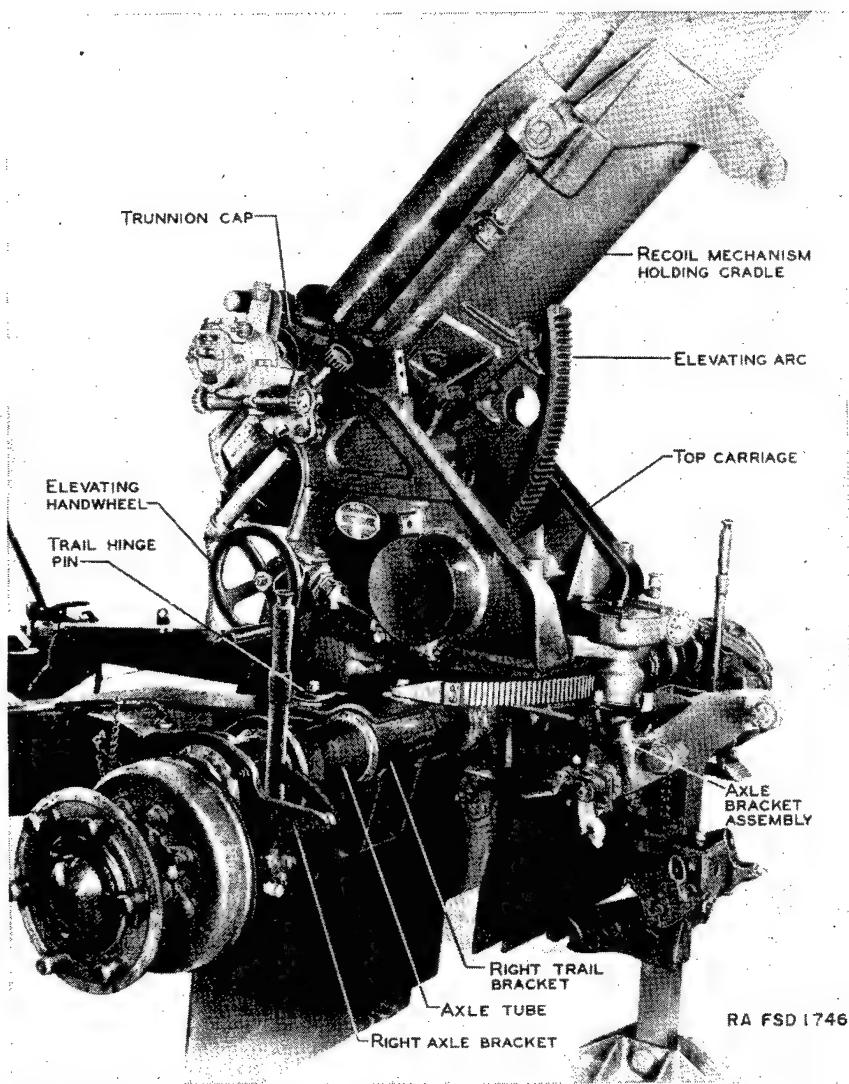


FIGURE 10.—75-mm gun carriage, M2A2, with shield and wheels removed, right side view.

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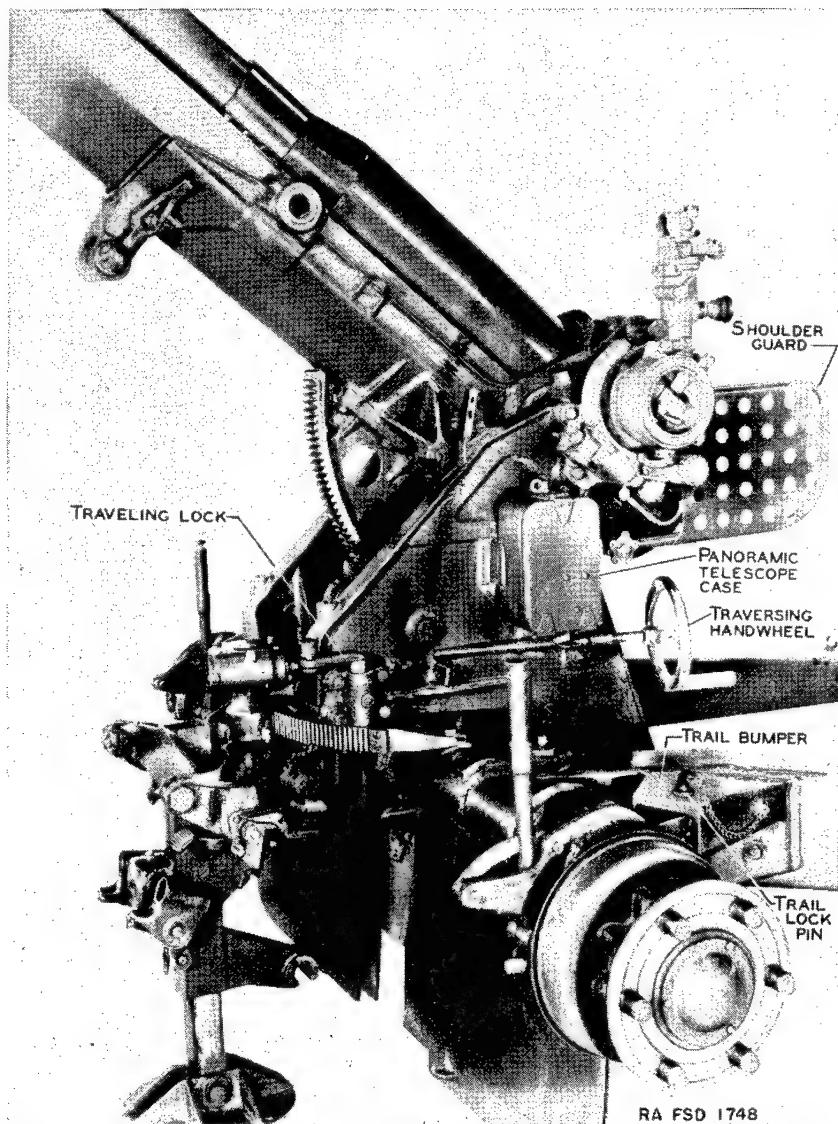


FIGURE 20.—75-mm gun carriage, M2A2, with shield and wheels removed, left side view.

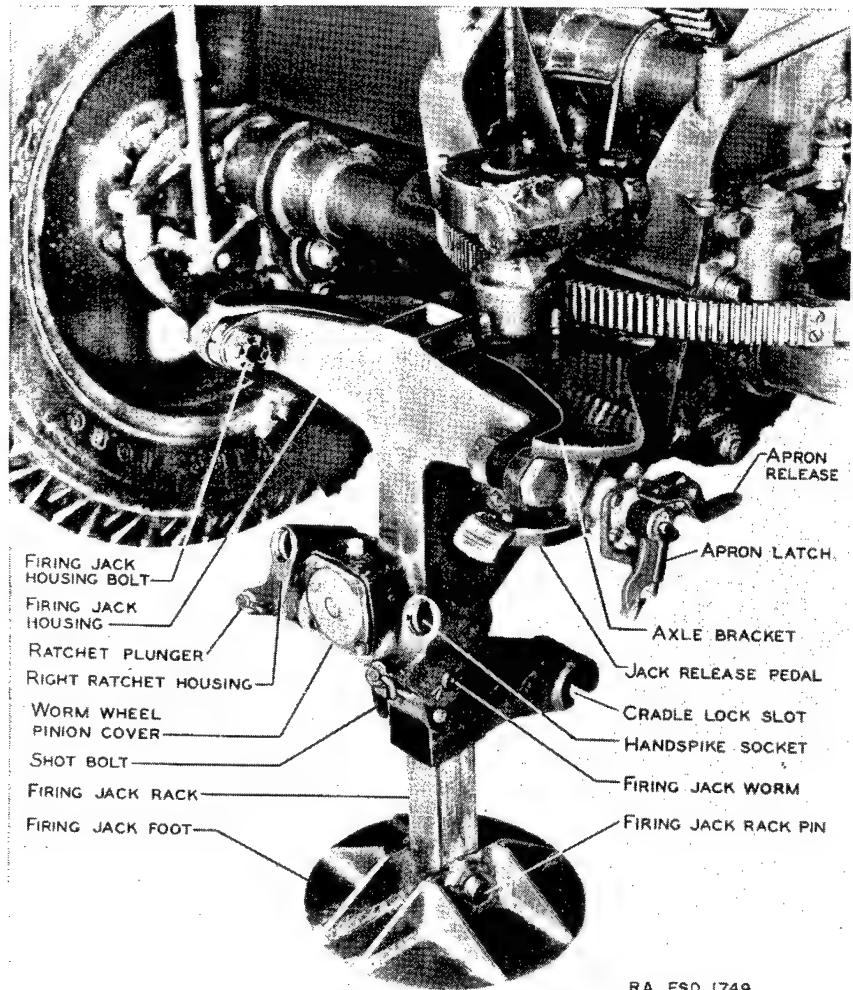


FIGURE 21.—Firing mechanism.

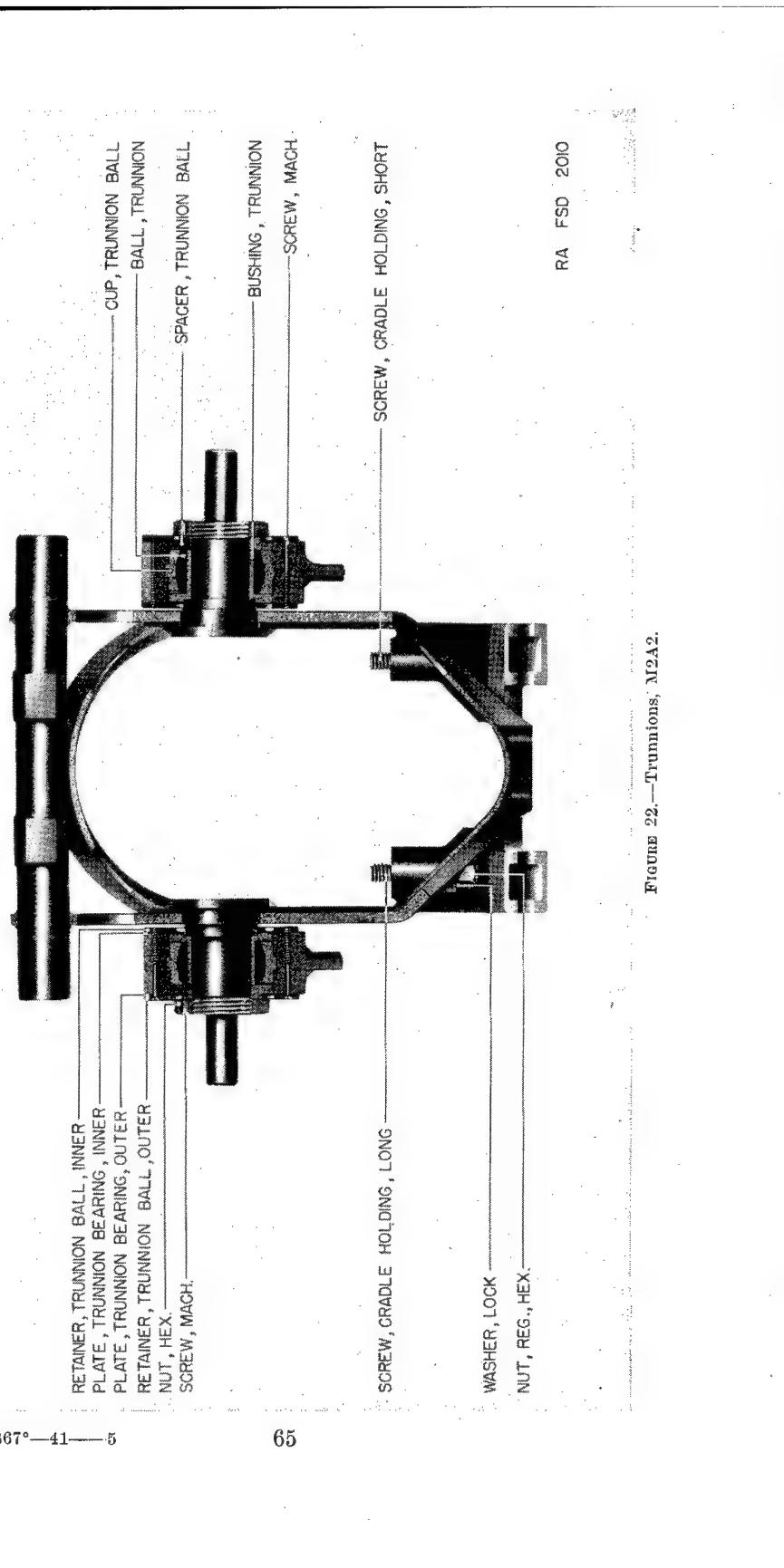
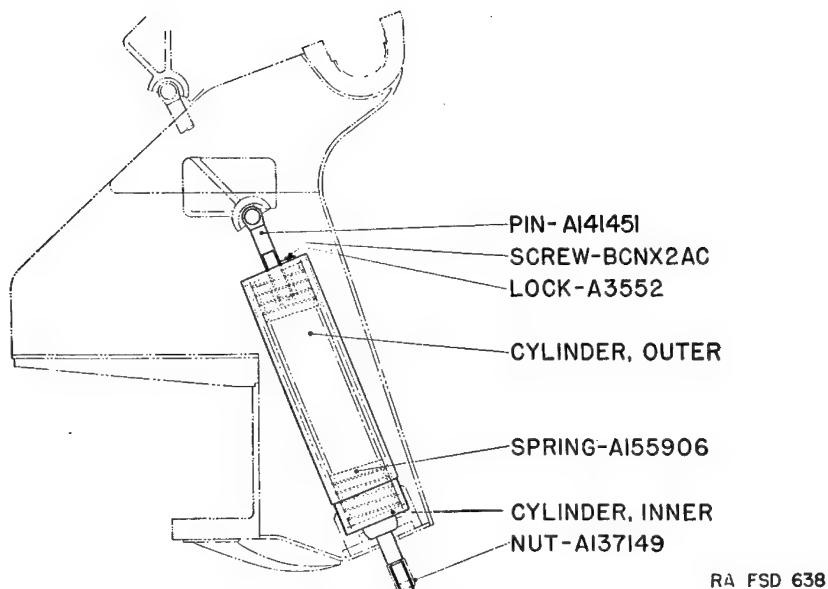


FIGURE 22.—Trunnions, M2A2.



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FIGURE 23.—Equilibrator.

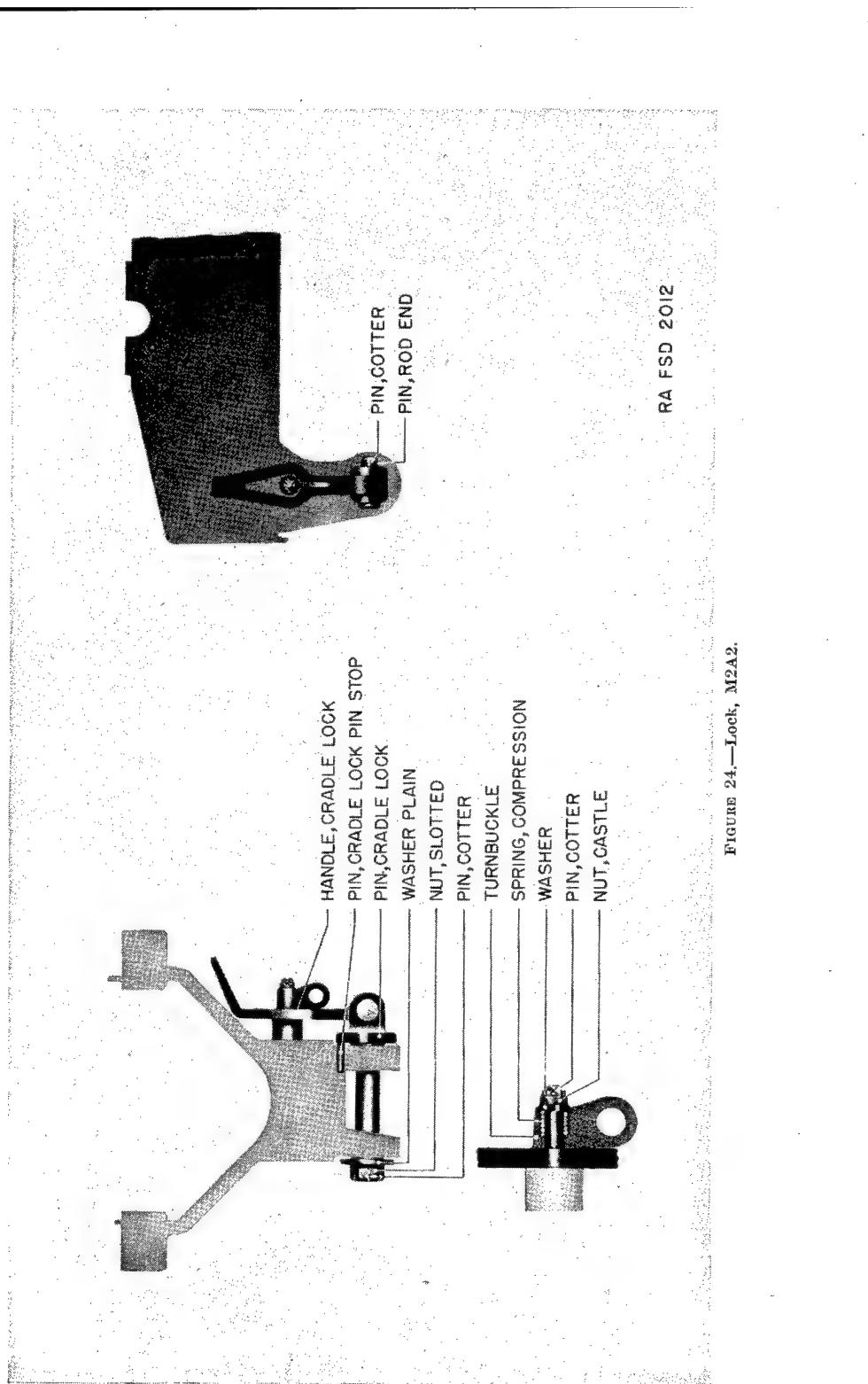


FIGURE 24.—Lock, M2A2.

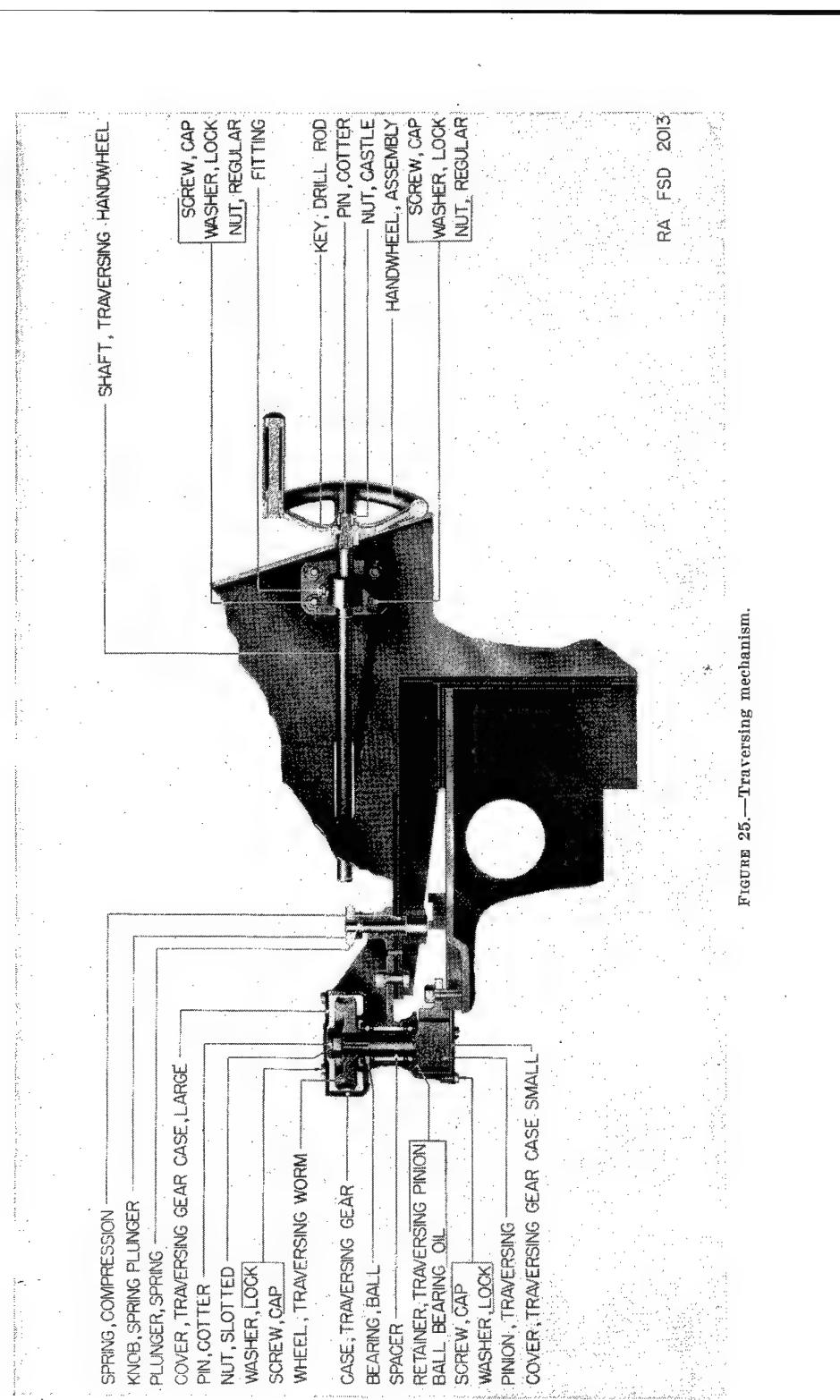


FIGURE 25.—Traversing mechanism.

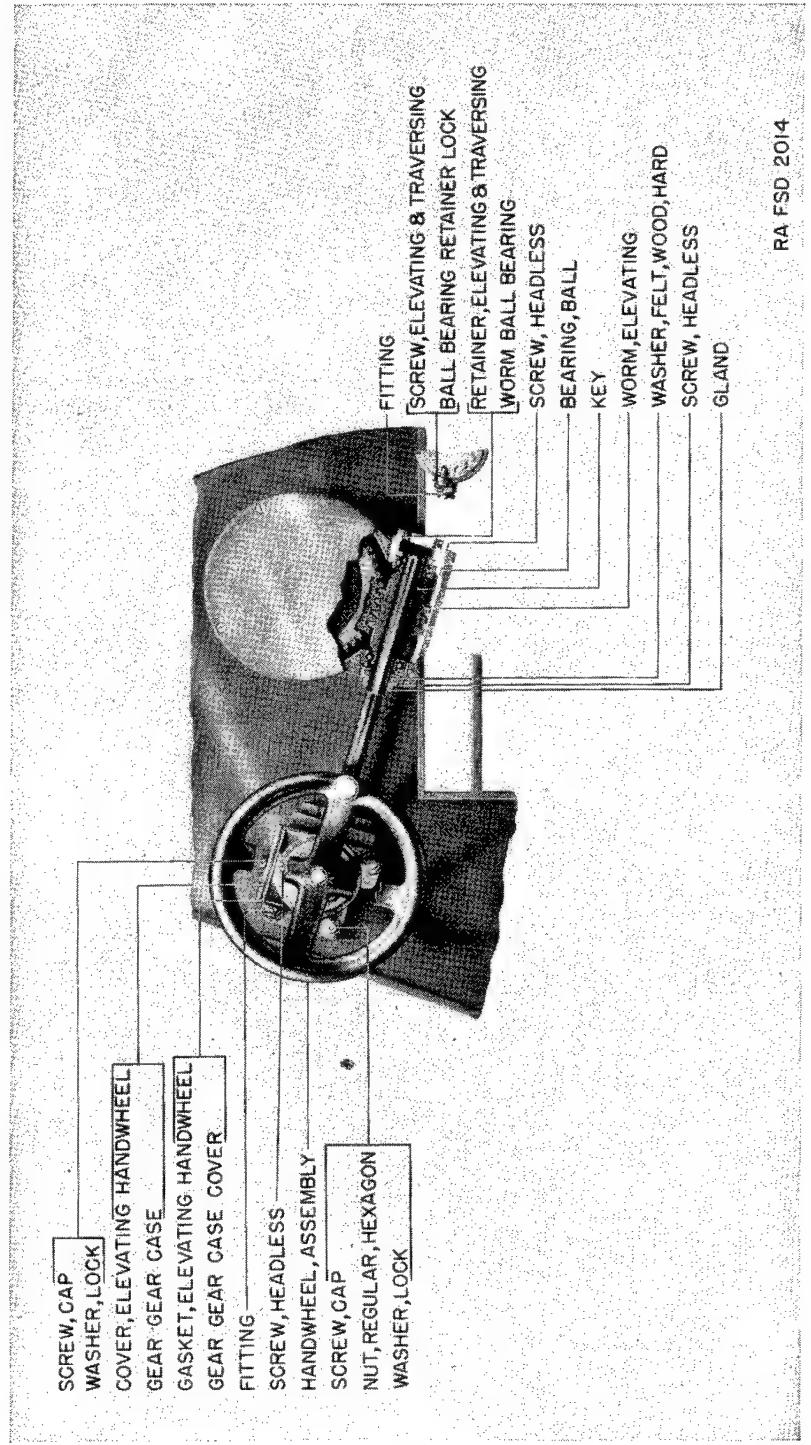


FIGURE 26.—Elevating mechanism, M2A2.

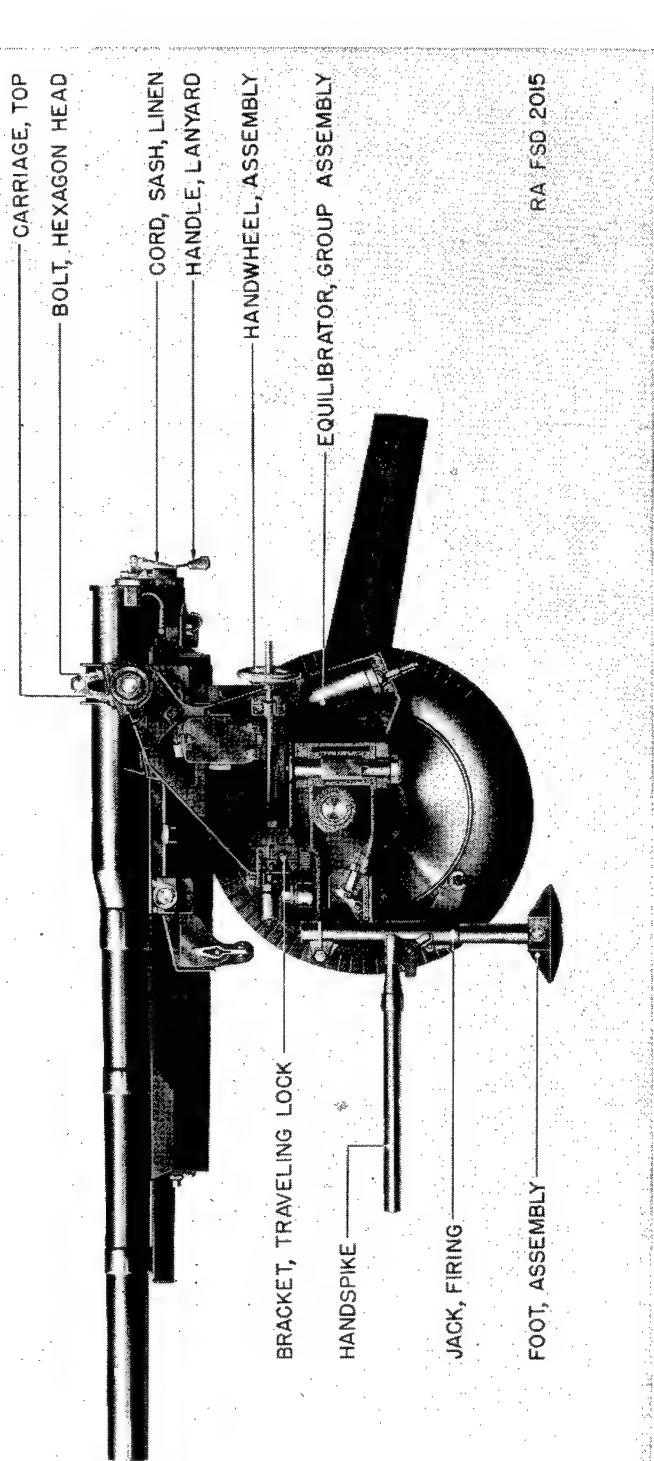


FIGURE 27.—75-mm gun carriage, M2A2, left elevation.

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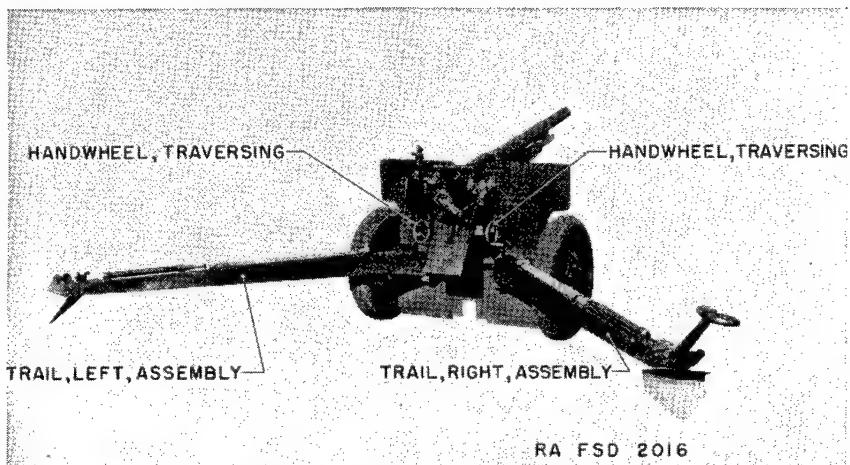


FIGURE 28.—M2A2 carriage, firing position.

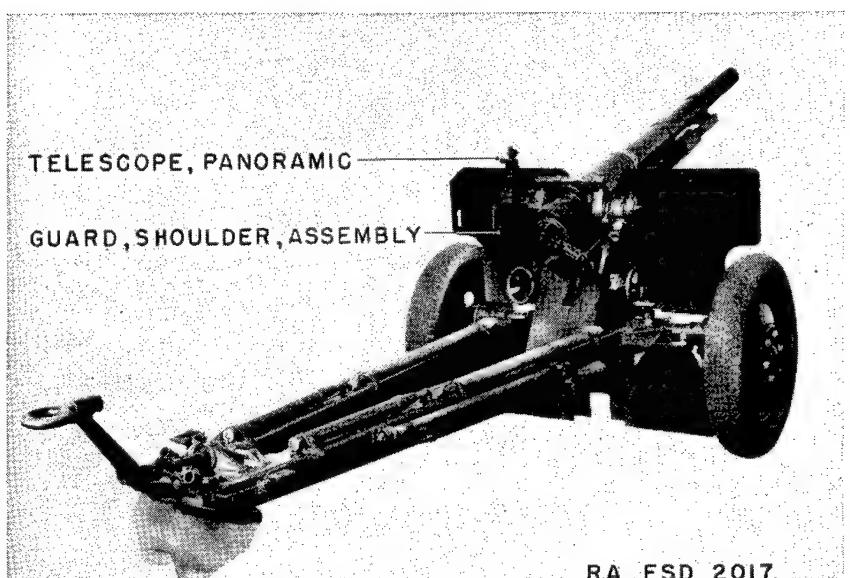


FIGURE 29.—M2A2 carriage, traveling position.

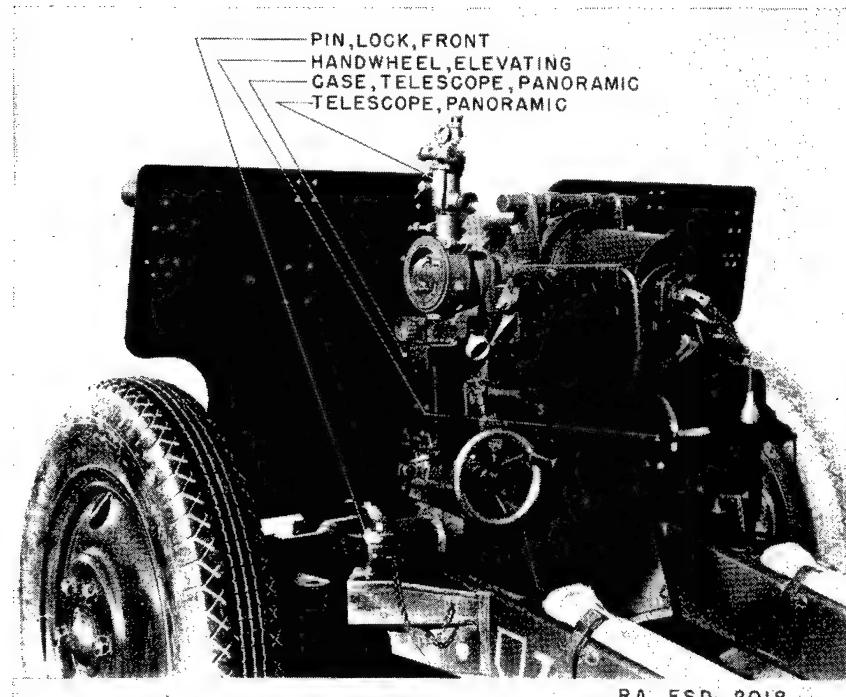


FIGURE 30.—M2A2 carriage, left side.

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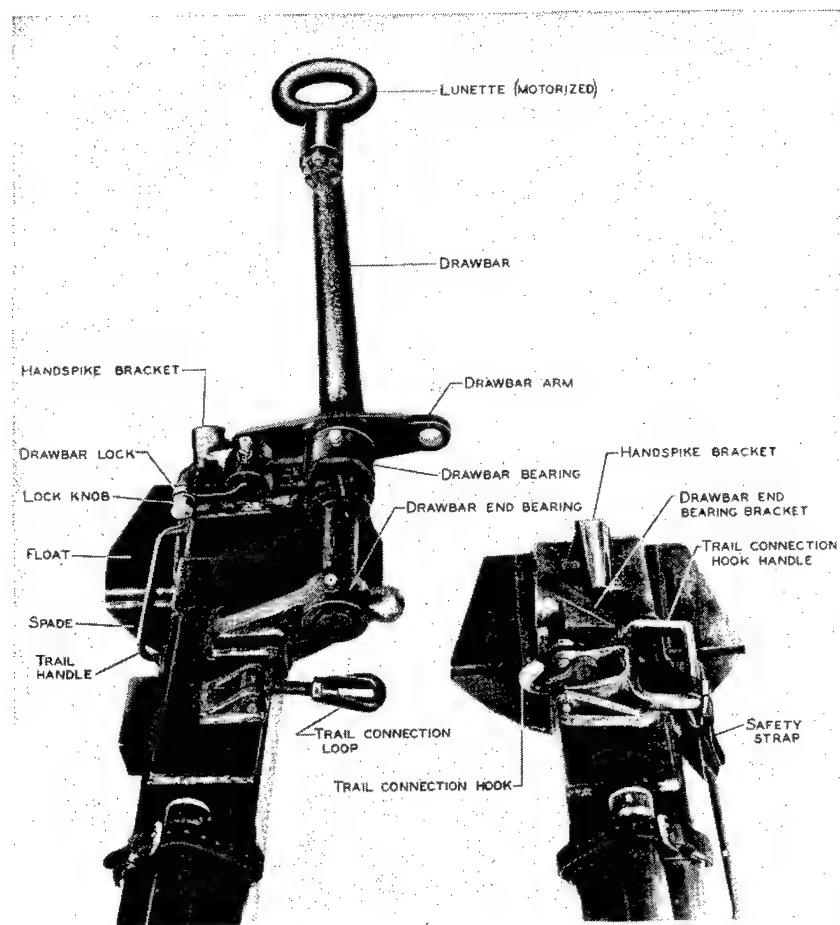


FIGURE 31.—Trail and spades, M2A2.

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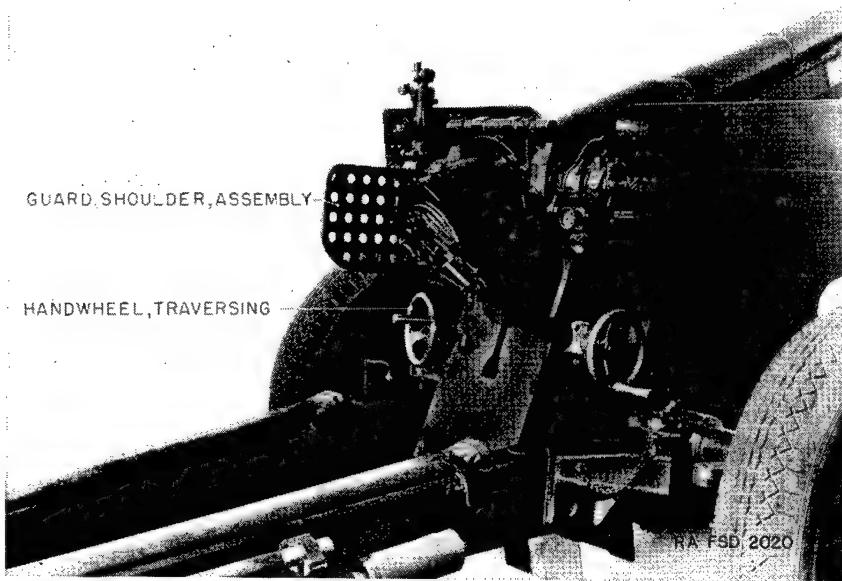


FIGURE 32.—M2A2 carriage, rear view.

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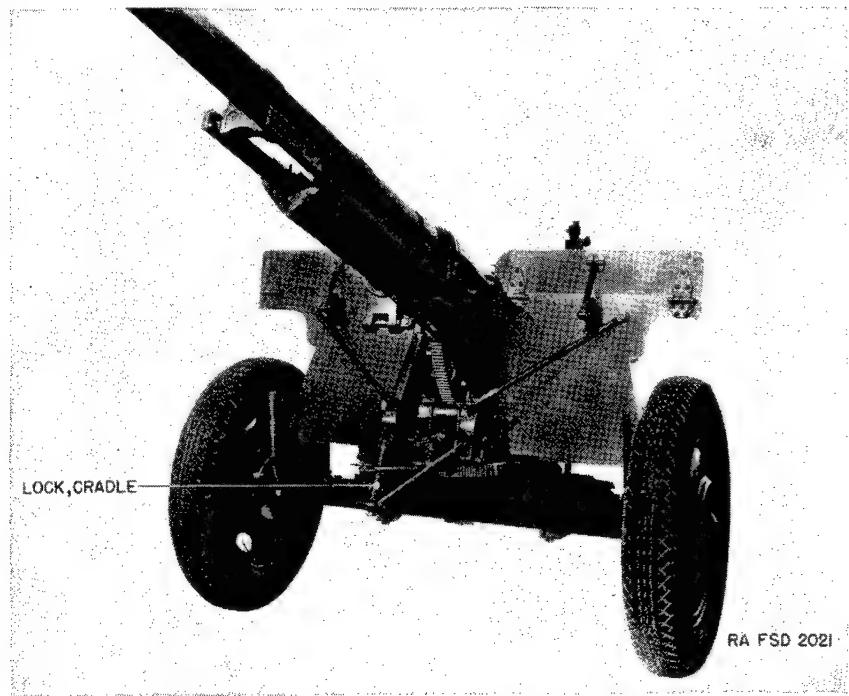
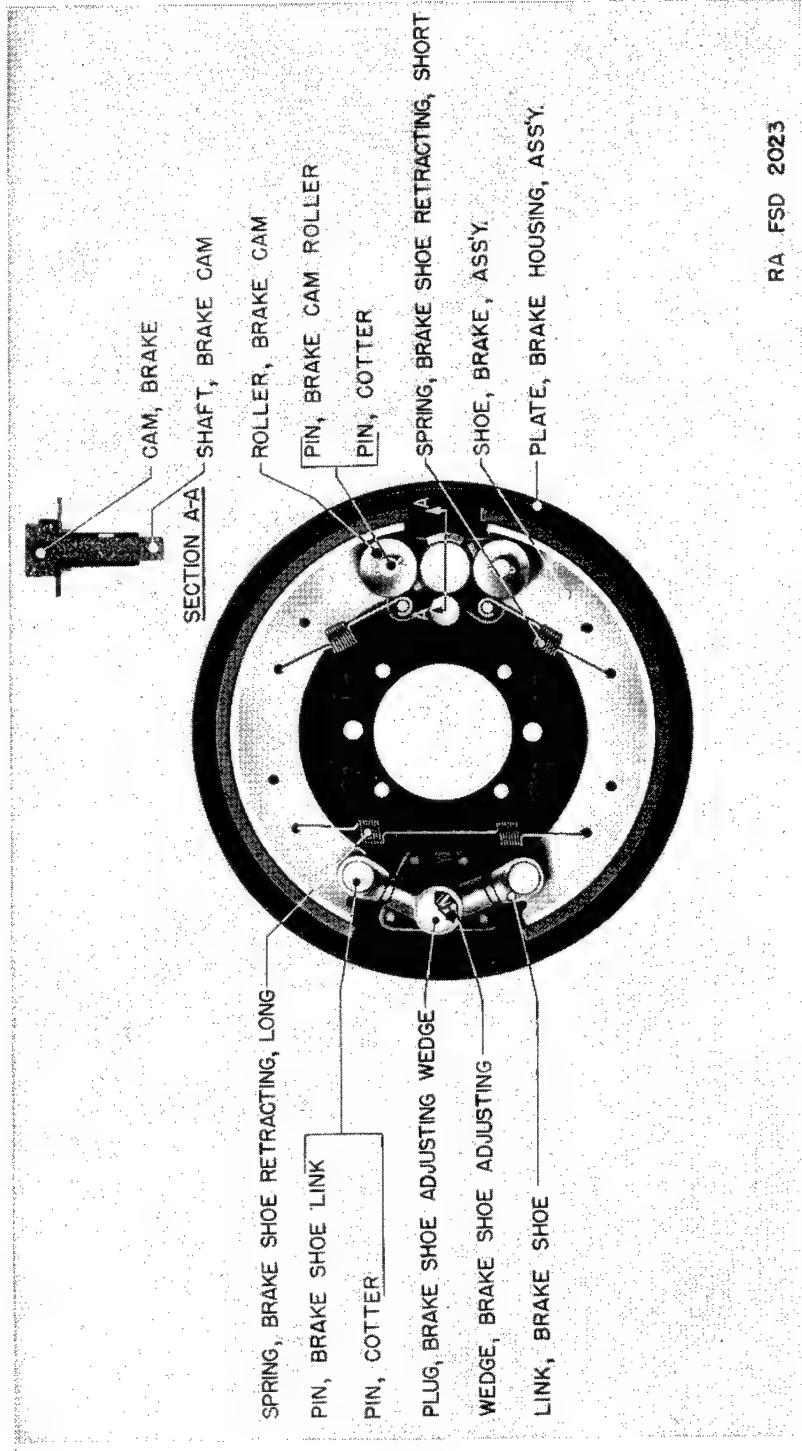


FIGURE 33.—75-mm gun carriage, M2A3, front view.



FIGURE 34.—75-mm gun carriage, M2A3, maximum depression.



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FIGURE 35.—Brake mechanism.

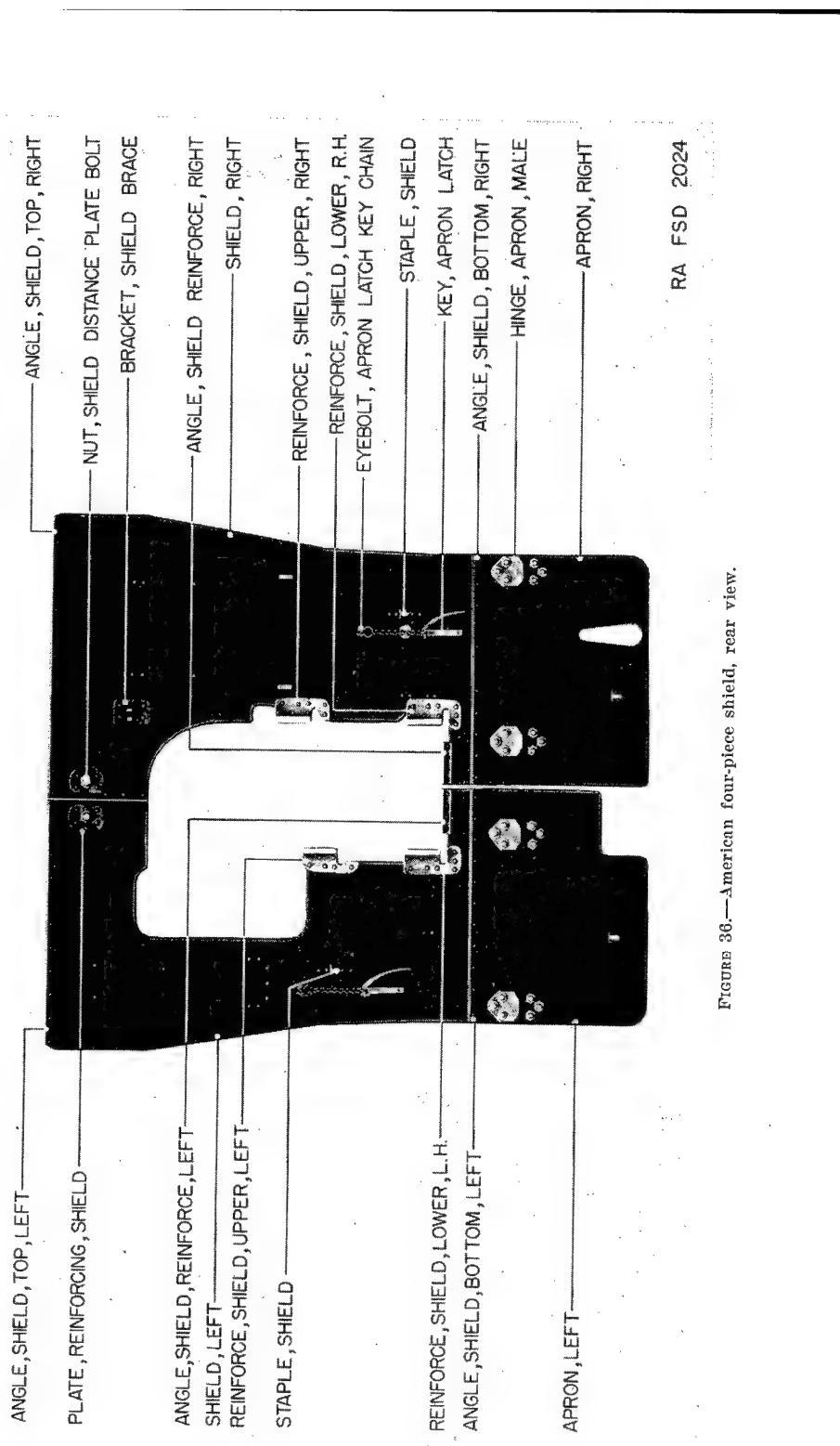


FIGURE 36.—American four-piece shield, rear view.

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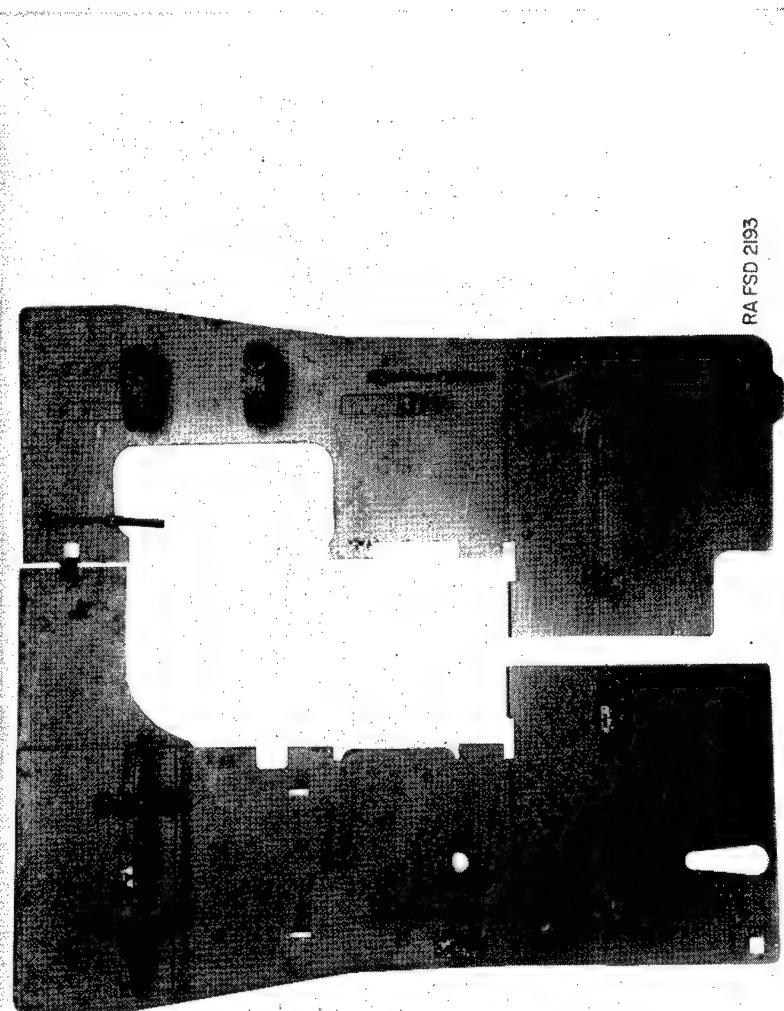


FIGURE 37.—French seven-piece shield, front view.

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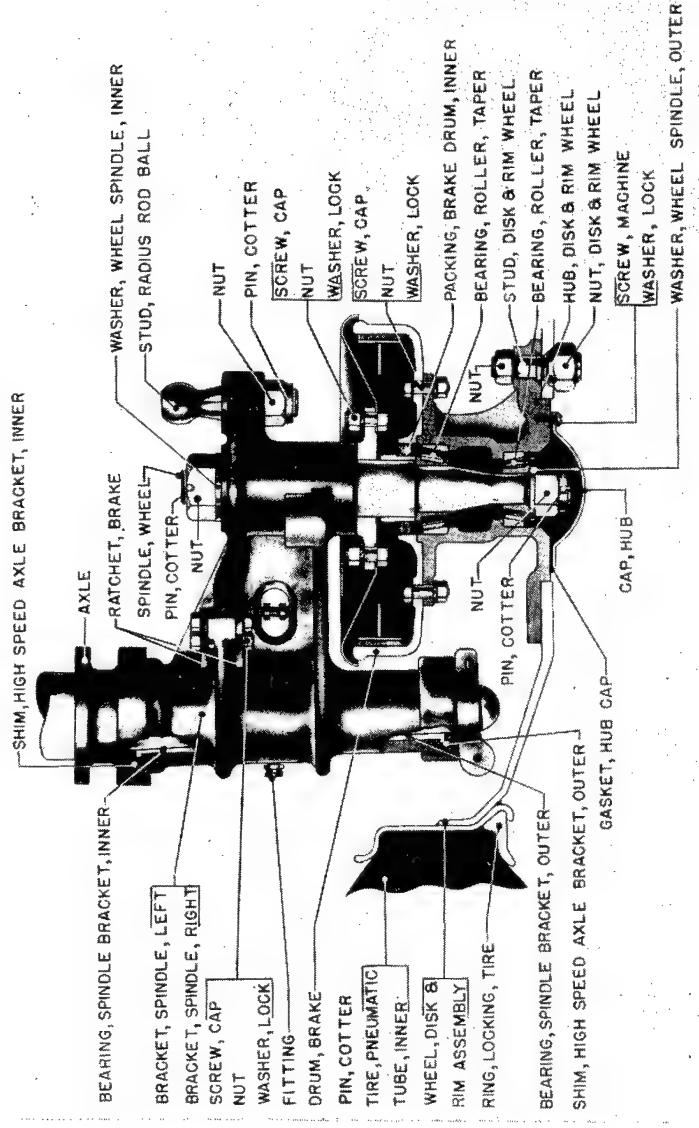


FIGURE 38.—Brake and axle bracket assembly.

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CHAPTER 3

SIGHTING AND FIRE-CONTROL EQUIPMENT

Section I. Sighting equipment-----	Paragraphs
I. Sighting equipment-----	43-51
II. Fire-control equipment-----	52-58

SECTION I

SIGHTING EQUIPMENT

Lamp, aiming post (lantern, M2)-----	Paragraph 43
Mount, telescope, M15 and panoramic telescope, M5 or M5A2-----	44
Mounts, telescopes, M15A1 and M22 and panoramic telescopes, M5A4 and M12A1-----	45
Post, aiming, M1-----	46
Quadrant, gunner's-----	47
Quadrant, range-----	48
Sight, bore-----	49
Sight, M1901 (French)-----	50
Target, testing-----	51

43. Lamp, aiming post (lantern, M2).—This equipment complete consists of two aiming lanterns, M2 (with red lenses), one extra green lens, two shields, and two adapters.

a. The aiming lantern, M2 (fig. 39), is a small lantern of the type formerly used extensively for automobile side lamps. The lantern has a nonlosable burner burning kerosene and delivering about 7 candlepower. A standard No. 00 ($1\frac{3}{8}$ inch) flat wick is used.

b. Aiming lantern adapter fits the mounting device on the rear of the lantern and clamps on an aiming post.

c. Shield snaps around the rim of the lens and serves as a hood to cut off stray light.

d. The lantern should be burned in a vertical position. Keep the wick trimmed and the lens clean. Do not turn the wick up so high that the lantern smokes. Top of the lantern becomes hot in use and care must be taken to have no combustible material in close proximity to it. When not in use keep the various parts in the chest.

44. Mount, telescope, M15 and panoramic telescope, M5 or M5A2.—This telescope and mount (fig. 40) furnished with each 75-mm gun and carriage, M2, M2A1, or M2A2, form the sighting element for aiming the gun. The mount is of the azimuth compensating

type, automatically applying the necessary azimuth correction for cant. It is mounted on the left side of the carriage. Telescope and mount are being equipped with instrument light, M7.

a. Description of mount.—The body of the mount, which supports the telescope socket, is positioned in part by a central pivot which is permanently alined to the bore of the gun. The body is also positioned longitudinally and in cross level by knobs operating worm drives. Two levels are provided. The cross level when centered indicates the normal line of sight of the telescope to lie in a vertical

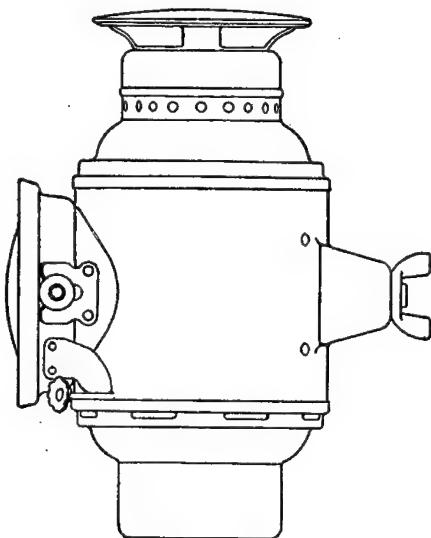


FIGURE 39.—Aiming lantern, M2.

plane parallel to the bore of the gun, while the longitudinal level when centered indicates the telescope to be vertical and hence deflections (azimuths) indicated on the scale are then measured in a truly horizontal plane. For traveling, a locking device is provided which holds the mount in the position shown in figure 41.

b. Description of telescope.—The panoramic telescope, M5 or M5A2, is a four-power telescope with a rotating head and azimuth mechanism by which the line of sight may be directed to any desired azimuth, and with a movable prism permitting the line of sight to be elevated or depressed through a limited angle as required to keep the aiming point within the field of view. The image viewed by the observer is erect. Both objective and eyepiece are the fixed focus type designed for normal eyesight and for ranges ordinarily encountered. The

reticle contains a vertical and a horizontal cross line, the latter being marked at 5-mil intervals and numbered at the 50-mil point on each side. The line of sight is elevated or depressed by means of the knob at the top, and coarse and fine index graduations are provided for the

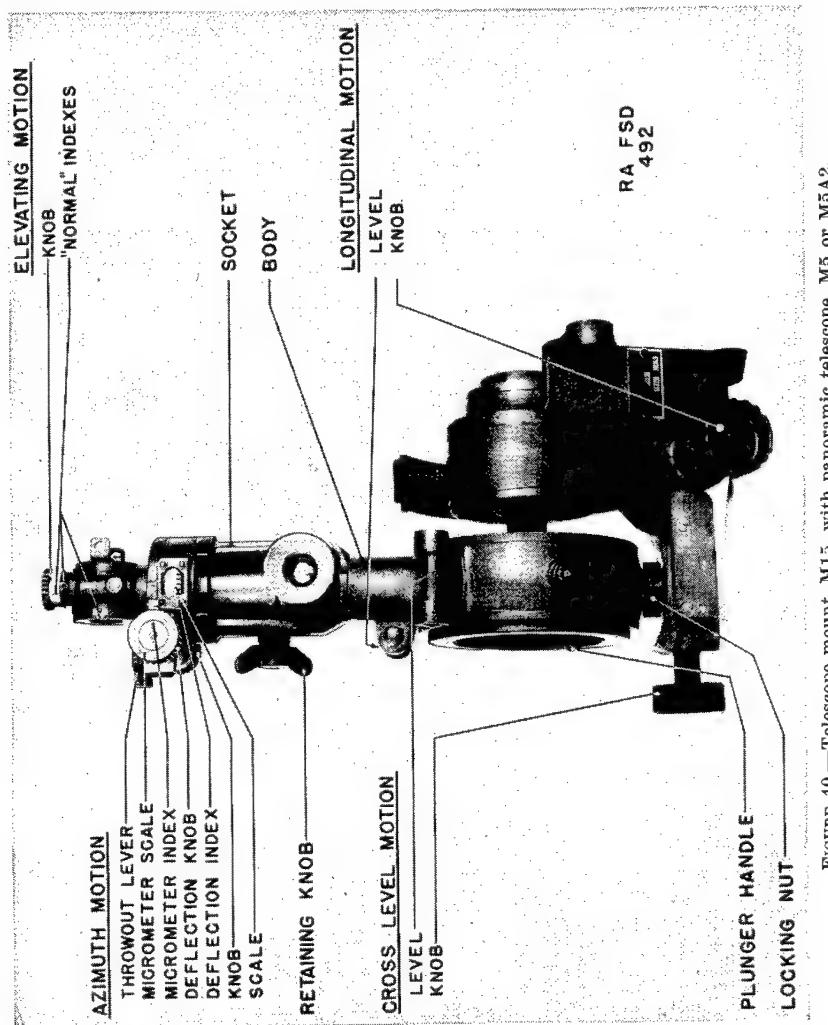


FIGURE 40.—Telescope mount, M15, with panoramic telescope, M5 or M5A2.

normal (zero elevation) position, but there are no means for reading other angles of elevation. The azimuth scale is graduated at 100-mil intervals, numbered progressively 0 to 32 in two consecutive semi-circles; zero readings indicate line of sight to be directly forward as in figure 40 or directly backward. The telescope is moved in azimuth by

means of the associated knob which has a throw-out lever to permit disengagement for rapid motion when required. Indications by the azimuth micrometer index opposite the black graduations of the associated scale which is graduated at 1-mil intervals supplement those on the azimuth scale. The micrometer scale also indicates deflections, black graduations for deflections to the left and red graduations for deflections to the right. The micrometer scale is arranged to be offset for insertion of corrections by means of the deflection knob. A detent on this motion gives a distinct click for each 1-mil movement and the

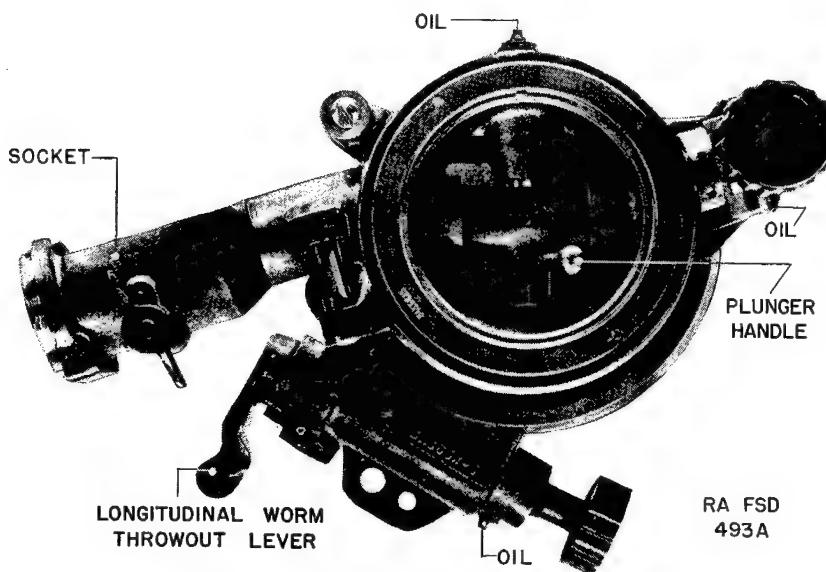


FIGURE 41.—Telescope mount, M15, traveling position.

total correction is indicated by the fixed deflection index. The telescope, which fits in cylindrical locating surfaces of the support, has a projecting lug to locate it correctly in azimuth. It is removable for traveling.

c. Operation.—(1) *Preparation.*—To place the mount and telescope in operation (fig. 41) remove the cover, grasp the socket in one hand and with the other push the plunger handle down, then to the left and release. Swing the socket to an approximately vertical position and with the free hand push the longitudinal worm throw-out lever clockwise until it snaps in place. Release the socket. Remove telescope from case. Turn the retaining knob to its extreme counterclockwise position and place telescope gently in the socket. Exert slight

pressure downward to insure that both top and bottom alining surfaces are firmly engaged. Uncover both levels.

(2) *Procedure*.—Operating procedure depends upon whether direct or indirect laying is to be employed, instructions for which are given separately. The procedure given is for uncorrected fire. Corrections ((5) below) are equally applicable to either kind of laying.

(3) *Direct laying*.—(a) Set telescope in elevation to normal and leave in this position as long as direct laying is used. Set micrometer scale to indicate zero deflection, opposite the fixed outer index.

(b) Set the lateral deflection to the desired value, using the combined indications on the azimuth scale (100-mil steps) and on the azimuth micrometer scale (1-mil steps). Deflections to left (trajectory displaced to left of line of sight) are indicated by the letter "L" and black scale designations. Deflections to right (trajectory displaced to right of line of sight) are indicated by the letter "R" and red scale designations. The azimuth scale has black numbering for left deflections only. For right deflections, subtract the value of the deflection from 3,200, or count the graduations backward from the zero of the azimuth scale. The azimuth worm may be disengaged for making large changes in deflection rapidly by depressing the throw-out lever.

(c) Operate the cross leveling knob of telescope mount so that bubble of the cross level is continuously centered with respect to the graduations on the vial as long as firing is continued. Operate the longitudinal knob of telescope mount so that the horizontal cross line of the telescope reticle remains continuously on the target. Disregard the position of the longitudinal level.

(d) Operate traversing handwheel on the gun carriage so that the vertical cross line of telescope reticle remains continuously on the target. The piece is then properly laid in direction for direct laying.

(4) *Indirect laying*.—(a) Set azimuth micrometer scale to indicate zero deflection opposite the fixed outer index.

(b) Set firing angle to desired value, using the combined indications on the azimuth scale (100-mil steps) and on the azimuth micrometer scale (1-mil steps). Disregard red markings on the scale. Firing angle is the horizontal clockwise angle, apex of which is at the piece, measured *from target to aiming point*. For values up to 3,200 mils it is numerically equal to the value indicated on the azimuth scale of the telescope, the rotating head being directed to right of line of fire. For values of firing angle greater than 3,200 mils, subtract 3,200 from the value of the angle and make the setting with the rotating head directed to left of line of fire. The azimuth worm

may be disengaged for making large changes in azimuth by depressing the throw-out lever.

(c) Operate the longitudinal and cross leveling knobs of telescope mount so that the bubbles of both levels are continuously centered with respect to the graduations on vials as long as firing is continued.

(d) Operate the traversing handwheel on the gun carriage so that the vertical cross line of the telescope reticle remains continuously on aiming point. The telescope may be elevated or depressed by the knob at the top as required to bring aiming point within field of view. It is not necessary to bring aiming point exactly on horizontal cross line. The piece is then properly pointed in direction for indirect laying.

(5) *Corrections.*—Corrections to firing angles or deflections may be introduced by using either of the two methods described below.

(a) *First alternative method.*—The micrometer scale is not offset but remains as originally set to indicate zero opposite the outer index. Corrections are introduced in the same manner as in making original azimuth or deflection settings by turning the azimuth micrometer index in the proper direction through the required number of 1-mil divisions.

(b) *Second alternative method.*—Each time the azimuth or deflection is set or changed, the micrometer scale is immediately rotated so that the azimuth micrometer index indicates zero. Corrections are introduced in the same manner as in making original azimuth or deflection settings, referred to zero on the scale in its new position. Before making such a setting, the indication should be checked to insure that a true zero indication is used as the starting point.

(6) *To place in travel position.*—When placing mount in traveling position, hold telescope to prevent its falling out through the open portion at rear of socket. Turn retaining knob counterclockwise which will lift and disengage the telescope. Remove telescope and place in case. Push plunger handle down and to the right and release. Operate the cross leveling mechanism of mount until the plunger is heard to snap up against the inner surface of the body. Grasp socket with one hand and with the other push the longitudinal worm throw-out lever counterclockwise until it snaps into its disengaged position. Lower socket downward and forward slowly until plunger snaps into place, locking the mount in its traveling position. The hole into which the plunger snaps is located in line with the oil fitting on the body, which may be used to indicate approximate alinement. A small amount of motion in cross level may also be necessary to

permit the plunger to snap into place freely. Protect both levels by closing their covers.

(7) *Night*.—For operation in darkness a window, exposed by turning the shutter located a short distance ahead of the eyepiece, permits illumination of the cross lines of the reticle, using an external light source (not included with the instrument). The shutter may be employed to regulate the amount of illumination.

d. Test and adjustment.—At conclusion of adjustment see that all screws and other parts loosened are made secure. No adjustment of the panoramic telescope other than authorized below is permitted.

(1) *Vertical bearing*.—Any play which may develop between the vertical stud on the cross leveling worm gear segment and the split bushing in the body must be removed by adjusting the locking nut sufficiently to remove the clearance. The locking nut has a set screw which must be loosened before adjusting and tightened when adjustment is complete.

(2) *Level*.—Level telescope mount by means of a test level placed on the flat machined surface of the telescope socket. Place level alternately longitudinally and transversely and operate the associated controls of the mount until a level indication is obtained simultaneously in both directions. The cross level bubble should then be central within one division and the longitudinal level bubble should be central within three divisions. No adjustment by the using arm is permitted. Levels are properly adjusted at the time instruments are assembled and it is seldom that future adjustment is necessary.

(3) *Bore sighting*.—Level piece transversely and longitudinally. Place bore sights in position and testing target vertically at a distance of about 50 yards so that axis of the bore passes through the point on the target so marked. Place telescope mount in operation for indirect fire, setting elevation at normal and firing angle and correction at zero. Line of sight and axis of the bore should then be parallel, and aiming point on the target should appear exactly at the intersection of the cross lines on the reticle. If this is not the case, further adjustment must be made as follows:

(a) If horizontal line on reticle is not in agreement with corresponding line on testing target, turn telescope elevating knob until these lines are in agreement. Then loosen locking screw in end of knob and slip knob around until the indexes are in agreement. Do not lift the knob during this adjustment as the stop rings within the knob may become disarranged. Tighten the locking screw, taking care not to disturb the adjustment. Should the coarse indexes then fail to

be matched, a serious maladjustment is indicated and the telescope should be turned in for repair.

(b) If vertical line on reticle is not in agreement with corresponding line on testing target, turn azimuth knob until lines are in agreement. Loosen deflection index locking screw and rotate index to zero indication, using the teat wrench. Tighten locking screw but do not disturb the adjustment. Should the azimuth scale then fail to indicate zero, a serious maladjustment of telescope or mount is indicated and the entire instrument should be turned in for repair.

(4) *Alinement of pivot.*—Alinement of axis of actuating arm pivot to be parallel with axis of bore of gun may be partially checked by elevating the gun, complying otherwise with conditions given for bore sighting. Failure of vertical cross line to remain on aiming mark indicates lack of alinement, necessitating turning in of the instrument.

e. *Care and preservation.*—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) Avoid striking or bumping any part of the instrument, and particularly denting or burring of locating surfaces of mount and telescope.

(3) When not in use keep the telescope in its case and the level vials covered.

(4) Stops are provided on the longitudinal and cross leveling motions of mount and on the elevating motion of telescope. Do not attempt to force rotation of any of the knobs beyond these limits.

(5) Be sure longitudinal worm is disengaged and plunger free to snap into the hole provided for it before attempting to place mount in traveling position and that the throw-out lever is returned to its extreme clockwise position when mount is placed in operating position. For travel, plunger handle should be kept in its upper position and worm throw-out lever should be kept in its lower position.

(6) Oil the principal bearing surfaces occasionally using neutral oil when temperatures are above 32° F., and using oil, lubricating, for aircraft instruments and machine guns, when temperatures are below 32° F. Three oil fittings are provided for this purpose (fig. 41). Also keep telescope retaining shaft and other parts well oiled. Keep locating surfaces of telescope, telescope socket, and retaining shaft lightly coated with petrolatum. Wipe off lubricant seeping from the moving parts to prevent accumulation of dust and grit. Exercise particular care to keep optical parts free from oil and grease.

45. Mounts, telescopes, M15A1 and M22 and panoramic telescopes, M5A4 and M12A1.—*a.* Panoramic telescope, M12A1, is now standard for these carriages but panoramic telescope, M5A4, made by converting existing components, will be manufactured until the former can be issued. Steps are being taken to replace all panoramic telescopes of the M5A2 type on 75-mm gun carriages, M2A1 and M2A2, with the M5A4 instruments. These panoramic telescopes differ from the M5A2 type in the following respects:

- (1) Eyepiece axis is offset 45° from bore axis.
- (2) Reticle, in addition to vertical and horizontal cross lines, has—
 - (a) Angular graduations to right and left at 5-mil intervals, numbered every 10 mils up to 40 mils.
 - (b) Range graduations at angles corresponding to elevation for zero (optical center), 400, 800, 1,200, and 1,600 yards when firing 75-mm HE shell, Mk. I, with normal charge at 1,784 foot-seconds.

b. Telescope mount, M15A1, is a modification of the telescope mount, M15, to accommodate the 45° offset of the eyepiece axis of the panoramic telescope.

c. Telescope mount, M22, is used on the 75-mm gun carriage, M2A3. It is designed to permit direct aiming, both in direction and elevation, by a single operator when required. Ordinarily it will be used for aiming in direction only as it has been found that speed and accuracy of fire are improved when the duties of aiming are divided between two operators. The range quadrant, M5, also used on these carriages has provision for direct aiming in elevation.

46. Post, aiming, M1.—This aiming post (fig. 42) consists of two tubular sections each approximately 4 feet long. The lower section has a metal point for embedding in the ground and the upper

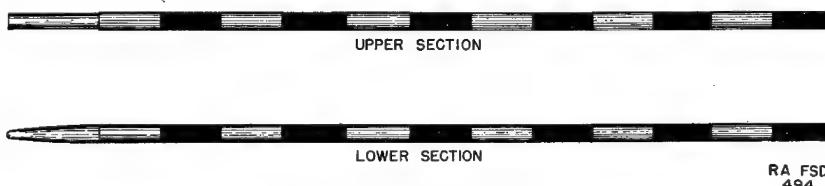


FIGURE 42.—Aiming post, M1.

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section is provided with a joint and catch fitting in the upper end of the lower section. The parts are painted with alternate 4-inch red and white bands. A canvas cover holding both sections is provided. If it is necessary to drive the lower section into the ground, interpose a wood block or use other means to insure that the surface mating with the upper part is not injured.

47. Quadrant, gunner's.—Each gunner's quadrant is furnished complete with packing chest.

a. M1918.—(1) *Description.*—This quadrant (fig. 43) includes a sector-shaped frame to which is pivoted an arm carrying a level. Notches on the frame engaging with a plunger in the arm permit rapid setting of the arm in 10-mil steps to the desired angle as indicated on the coarse scale. The arm is slightly curved and the level guide is arranged to be positioned along the arm to provide a fine indication supplementing that on the coarse scale. The frame has

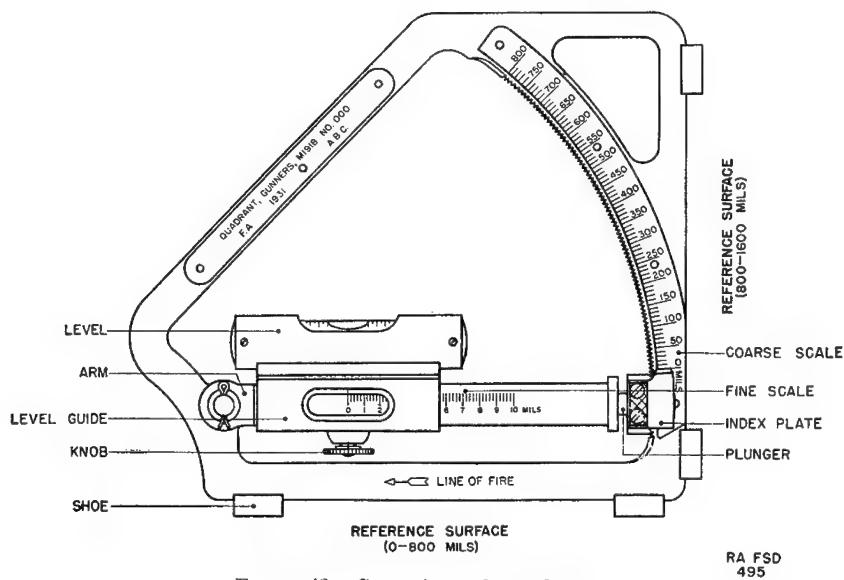


FIGURE 43.—Gunner's quadrant, M1918.

two reference surfaces, one used for elevations from 0 to 800 mils and the other from 800 to 1,600 mils. Separate indications on opposite sides of the quadrant are used for the two different regions.

(2) *Operation.*—(a) To measure elevation of the piece, place proper reference surface of the quadrant on leveling plates parallel to the bore with the associated arrow pointing in the direction of fire. Clamp level guide to indicate zero on the fine scale. Disengage plunger from notches in frame, lift arm and slowly lower it until bubble is seen to pass through the central point. Allow plunger to engage with notches and slide level guide along the arm until level bubble is accurately centered. Face side of the quadrant which bears the arrow in use and read the coarse and fine scales. Elevation of the

piece in mils is equal to the sum of the coarse and fine scale readings. Remove quadrant from piece before firing.

(b) To measure depression angles proceed as above, but with arrow pointed in the reverse direction.

(c) To lay the piece to a given elevation, set scale and micrometer to required angle and place corresponding reference surface on leveling plates of piece. Elevate piece, then depress it until level bubble is centered. Remove quadrant from piece before firing.

(3) *Test and adjustment.*—(a) No adjustment of the quadrant by using arm is permitted.

(b) The zero indication may be verified by setting the quadrant to zero elevation, elevating or depressing piece to center the bubble, then turning quadrant end for end. If bubble is not centered, determine the elevation or depression angle necessary to center it; one-half of this angle is the error and a corresponding correction should be applied to all subsequent indications in the 0-800 mil region.

(c) To test accuracy of the arm, clamp level guide to indicate zero on the fine scale and set arm to any convenient multiple of ten on the coarse scale. Center bubble by elevating or depressing piece. Move arm down one notch and slide level guide to indicate 10 on the fine scale. Bubble should remain central.

b. *M1.*—(1) *Description.*—This quadrant (fig. 44) includes a sector-shaped frame to which is pivoted an arm carrying a level. Notches on the frame engaging with a plunger in the arm permit rapid setting of the arm to desired angle. The frame has two reference surfaces, one used for elevations from 0 to 800 mils and the other from 800 to 1,600 mils. Separate scale and micrometer indications on opposite sides of the quadrant are used for the two different regions.

(2) *Operation.*—(a) To measure the elevation of the piece place proper reference surface of quadrant on leveling plates parallel to bore with the associated arrow pointing in the direction of fire. Set micrometer to zero. Disengage plunger from notches in the frame, lift arm and slowly lower it until bubble is seen to pass through the central point. Allow plunger to engage with notches and turn micrometer until level bubble is accurately centered. Face side of quadrant which bears the arrow in use and read the scale and micrometer indications. A note engraved below the micrometer indicates whether red or black micrometer figures are to be read. A zero micrometer indication is read as 0 mils when the auxiliary indexes are matched (as in fig. 36) and as 10 mils when they are not matched. Elevation of the piece in mils is equal to the sum of the scale and micrometer readings. Remove quadrant from the piece before firing.

(b) To measure depression angles proceed as above, but with arrow pointed in reverse direction.

(c) To lay the piece to a given elevation, set scale and micrometer to the required angle and place the corresponding reference surface on leveling plates of piece. Elevate piece, then depress it until level bubble is centered. Remove quadrant from piece before firing.

(3) *Test and adjustment.*—No adjustment of quadrant by using arm is permitted. The zero indication may be verified by setting quadrant to zero elevation, elevating or depressing the piece to center

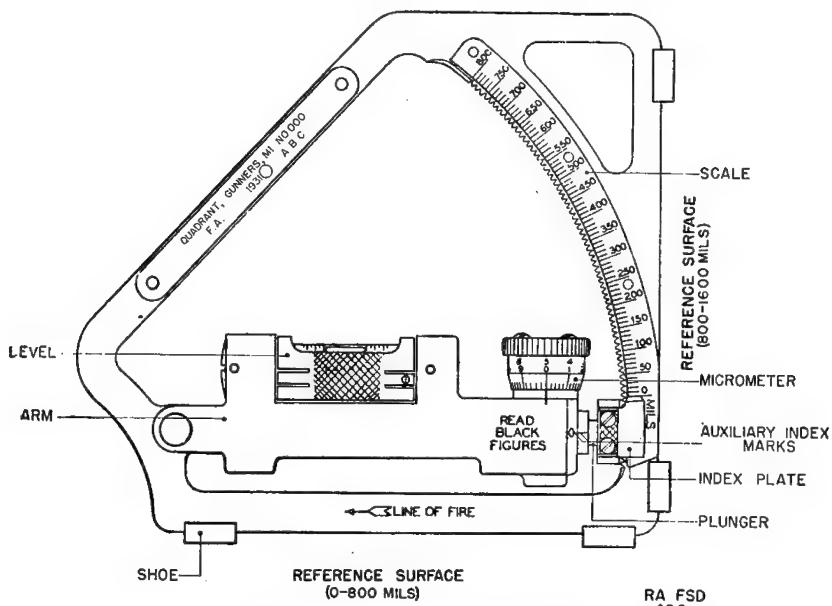


FIGURE 44.—Gunner's quadrant, M1.

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the bubble, then turning quadrant end for end. If the bubble is not centered, determine elevation or depression angle necessary to center it. One-half of this angle is the error and a corresponding correction should be applied to all subsequent indications in the 0-800 mil region.

(4) *Care and preservation.*—(a) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(b) Exercise particular care to prevent burring, denting, or nicking of the reference surfaces and of the notched portion of the frame.

(c) Never leave quadrant on the piece when firing.

(d) When not in use keep quadrant in its chest with the shoes forming the reference surfaces lightly greased with petrolatum.

48. Quadrant, range.—*a. M1.*—This range quadrant (fig. 45) furnished with each 75-mm gun and carriage, M2A1 or M2A2, is used for laying the gun in elevation. It is mounted on the right-hand side of the carriage in prolongation of the axis of cradle trunnions. Settings are made on the quadrant in accordance with data from external sources and the proper laying of the gun is then accomplished by matching a pair of indexes.

(1) *Description.*—(a) The quadrant includes a level and leveling mechanism for establishing a horizontal datum plane, angle of site and angle of elevation mechanisms which introduce and add together their respective elements of data, a range drum whereby range settings may be made in lieu of angle of elevation settings, and a pair of indexes to indicate actual and computed gun positions.

(b) These range quadrants are being equipped with instrument light, M6. This light includes a battery case on which is mounted a lamp housing with reflector and a finger light with flexible cord attached thereto.

(2) *Operation.*—(a) To operate the quadrant, any one of the three following combinations of data may be employed:

1. Angle of site in mils. Angle of elevation in mils.
2. Angle of site in mils. Range in yards (using only ammunition specified on range drum).
3. Quadrant elevation in mils (set as angle of elevation with angle of site set at normal (300 mils) since quadrant elevation already includes any necessary angle of site).

(b) Having made the necessary settings in accordance with the combination selected from the above listing, level quadrant by either of the leveling knobs, then elevate gun and depress it so that indexes are properly matched. Gun is then properly laid in elevation. Maintain the level in its central position and the indexes matched as long as firing is continued.

(c) To place in traveling position cover the level.

(3) *Test and adjustment.*—The various indexes all have slotted mounting holes to permit their alinement in the correct positions. Both micrometer and range drum are clamped in place by a nut or screws in their respective knobs, permitting adjustment to the proper indications. All required adjustments may be made by these means. Adjustment of level tube in its mounting is not permitted. To check and adjust instrument, proceed as follows:

(a) Set angle of elevation to zero. Scale and micrometer should indicate zero simultaneously. If they do not, shift micrometer or index or both to give required indication. With this setting zero

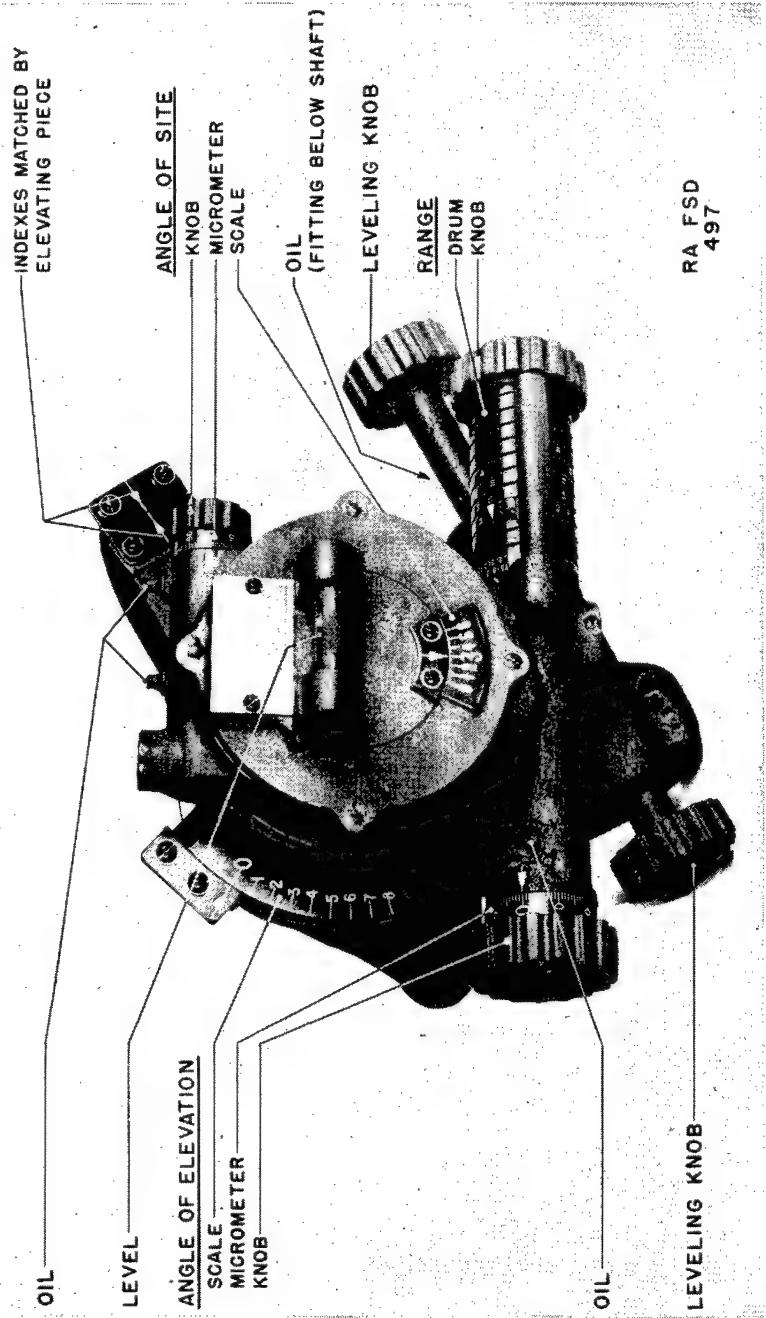


FIGURE 45.—Range quadrant, M1.

range should also be indicated. If not, shift range drum to give required indication.

(b) Set angle of site to normal (300 mils). Scale and micrometer should indicate, respectively, 3 and 0 simultaneously. If they do not, shift micrometer or index or both to give the required indication. Place bore of gun in a horizontal position. Level the range quadrant. If the matching indexes are not then in alinement, adjust one or both until the proper indication is obtained.

(c) Should any index reach the limit of adjustment, one of the other indexes may be shifted in the proper direction to correct the difficulty, and the adjusting procedure repeated.

(d) Be sure adjusting nut and screws are securely tightened at completion of the adjusting operations.

(4) *Care and preservation.*—(a) Avoid striking or bumping any part of the instrument.

(b) Keep level vial covered at all times when not in use.

(c) Stops are provided to limit the motion of the revolving parts. Do not attempt to force the rotation of any of the knobs beyond these limits.

(d) Oil the principal bearing surfaces occasionally, using neutral oil when temperatures are above 32° F. and using oil, lubricating, for aircraft instruments and machine guns when temperatures are below 32° F. There are four oil fittings provided for this purpose. Wipe off any lubricant seeping from the moving parts to prevent accumulation of dust and grit.

b. *M5.*—This range quadrant is used on the 75-mm gun carriage, M2A3. It has provision for mounting an elbow telescope for direct aiming of the piece in elevation.

49. **Sight, bore.**—The bore sight is used to indicate the direction of axis of bore of the gun for alinement and verification of sights. Each bore sight is composed of a breech element and a muzzle element.

a. *Description.*—(1) The breech bore sight (fig. 46) is a disk which fits accurately in the breech chamber of the gun. Model of gun for which it is to be used is engraved on the disk.

(2) The muzzle bore sight includes a quantity of black linen cord to be stretched tightly across the muzzle vertically and horizontally in the score marks thereon, and a web belt to be buckled around the muzzle to hold the cord in place.

b. *Operation.*—With the two elements in place, look through the aperture in the breech bore sight. Direction of axis is indicated by the cord intersection.

c. Care and preservation.—Handle breech bore sight carefully to prevent nicks and burs. Wind the cord and web belt into a compact bundle when not in use.

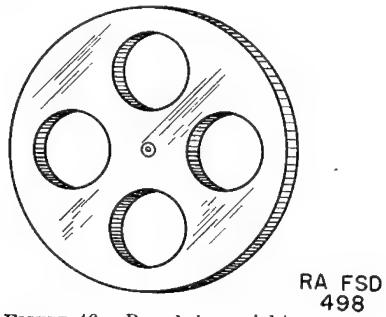


FIGURE 46.—Breech bore sight.

50. Sight, M1901 (French).—This sight (fig. 47) furnished with each 75-mm gun and carriage, M1897MI, M1897MIA2, or M1897A4, is the element by which the piece is aimed in direction and laid or aimed to the correct angle of site. No correction for cant is applied.

a. Description.—The collimator, attached to a long shank with a removable extension, is arranged to be turned to any required value of azimuth or lateral deflection. The entire sight is elevated or depressed by the angle of site handwheel of the gun carriage, angle of site being introduced either directly (aimed fire) by means of the collimator line of sight, or indirectly (laid fire), using a level which is arranged to be inclined as required through a limited range. These sights are being equipped with the instrument light, M3, operated from a flashlight cell and carried on the shield of the carriage.

b. Operation.—(1) To place the sight in service, remove cover from sight mount, uncover level, remove collimating sight from carrying case and place in socket of sight mount, taking care that forked projecting arm properly engages the mating parts. When aiming point is above or below the limits of the collimator, withdraw auxiliary collimator from its recess and turn it to the position shown.

(2) Initial settings depend on whether direct or indirect laying is to be used. For indirect laying, settings of azimuth and angle of site are made. For direct laying, a setting of lateral deflection is made.

(3) Azimuth settings are made in two steps.

(a) "Coarse" settings are made on the azimuth scale (referred to as the "plateau") which is arranged to be set and read in steps of 200 mils. To make this setting, press down on shank until it is free to

rotate, then turn it so as to bring index line thereon to desired graduation on azimuth scale and release.

(b) "Fine" settings are made using the deflection knob and the associated scale (referred to as the "drum"). A clamping lever is pro-

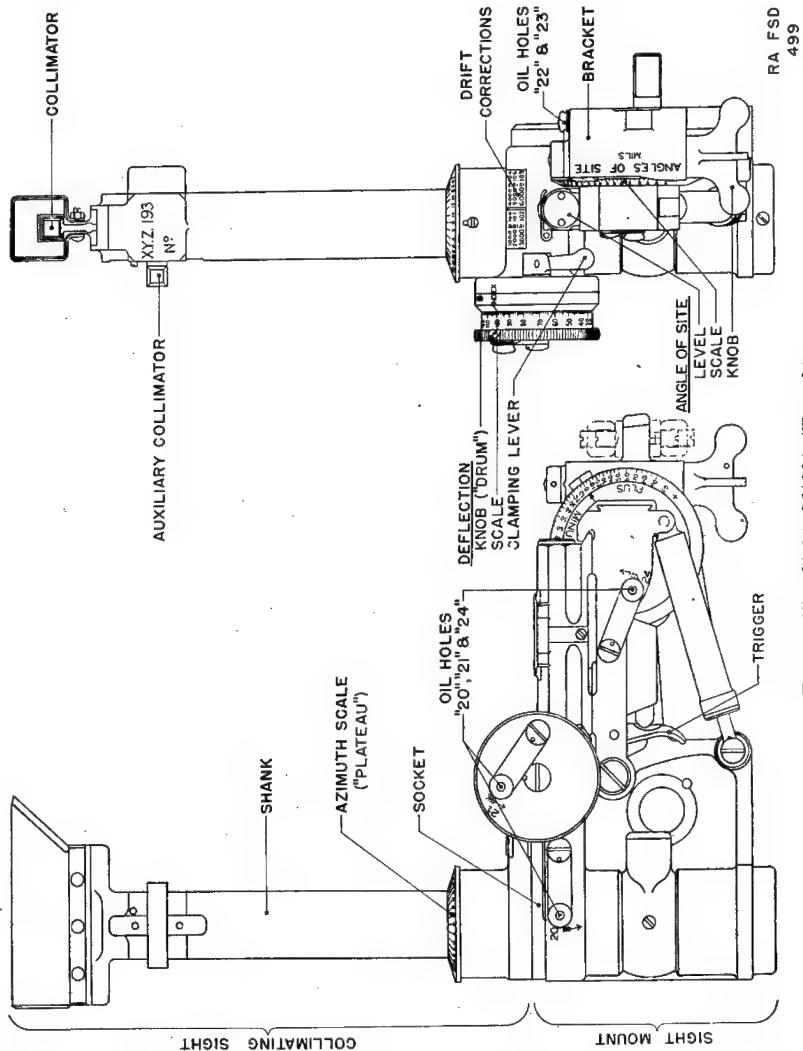


FIGURE 47.—Sight, M1901 (French).

vided which must be tightened to prevent shifting of the setting during firing.

(c) The value of the setting is the sum of fine and coarse (drum and plateau) settings. Be certain that the proper quadrant is used

when making azimuth settings, as four positions with the same angular indication are possible. The line of sight is parallel or perpendicular to a vertical plane through axis of bore when plateau is at zero and drum is at 100.

(d) To correct these settings to true azimuths as indicated on some fire-control instruments now in general use, subtract 100 mils. In the first quadrant, the result is the azimuth; in the second, third, or fourth quadrants, add 1,600, 3,200, or 4,800 mils, respectively.

(e) Azimuths as employed in this sight are measured in a slant plane through the target, not in a horizontal plane. The difference is usually negligible, except when the angle of site is large.

(4) Deflection settings are made in the same manner as azimuth settings.

(a) Note that a reading of 100 on the deflection scale corresponds to zero deflection angle.

(b) Increasing deflections (knob turned toward breech) on this scale displace the trajectory toward the left. Decreasing deflections (knob turned toward muzzle) displace it toward the right.

(c) An engraved table of deflections to correct for drift at various ranges is provided on the sight mount. As on the deflection scale, 100 mils corresponds to zero drift.

(5) Angle of site settings are required only when the piece is to be laid in angle of site.

(a) On instruments of French manufacture the angle of site scale and auxiliary level are calibrated in terms of the "infantry mil", a slightly larger unit than the standard American "artillery mil" (1/6400 of a circle). Sight mounts and levels are appropriately marked so that the unit can be readily ascertained. Conversion, when necessary, is as follows:

$$100 \text{ artillery mils} = 98.2 \text{ infantry mils.}$$

$$100 \text{ infantry mils} = 101.8 \text{ artillery mils.}$$

(b) For angles numerically less than ± 100 mils use the angle of site level. For larger angles up to ± 300 mils, remove angle of site level and substitute auxiliary angle of site level. A level is readily released by depressing the trigger and then removed by a slight forward movement. When auxiliary level is placed with the +200 inscription toward the rear, add 200 mils to scale indications. When it is placed with the -200 inscription toward the rear, subtract 200 mils from scale indications.

(c) Rotate angle of site knob until the desired indication appears on the associated scale. If auxiliary level is used, add or subtract

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200 mils as noted above. Plus angles of site are for target above the piece; minus angles for target below the piece. A zero indication corresponds to a level line of sight.

(6) To use the sight, place the eye approximately 10 inches to rear of collimator. When the eye is so placed, the cross of the collimator reticle will be seen. Move the eye so that the field of view is seen. To obtain a rapid alinement above or below the limits of the collimator, an auxiliary collimator with a vertical line only on the reticle is provided. In addition the cover over the collimator may be used as an open sight.

(7) (a) For direct laying, operate traversing and angle of site handwheels so that the reticle cross appears on the target. No setting of angle of site is required.

(b) For indirect laying, operate traversing handwheel so that vertical line of reticle cross is alined with aiming mark and operate angle of site handwheel so that angle of site level bubble is centered.

(8) The sight extension is to be used only when vision is obscured by the shield or other carriage part. It must be removed when the piece is fired and when traveling. It is readily installed by lifting collimating site from sight mount socket, inserting the extension, and collimating sight in a similar socket in the extension, taking care that the forked projecting arms properly engage with the mating parts.

(9) To prepare the sight for traveling, turn auxiliary collimator to vertical position and allow it to retract in recess provided, remove collimating sight and place it in carrying case, cover level, and place cover over sight mount.

c. *Test and adjustment.*—No adjustment of the sight by the using arm is permitted. The collimator line of sight and the angle of site level should however be frequently verified. This verification involves not only the sight itself, but also the proper alinement of certain carriage parts and the minimizing of errors due to friction and lost motion therein. Full instructions are given below.

(1) Verification of the sight consists in ascertaining that—

(a) Optical axis of collimator is parallel to axis of bore of gun when range and azimuth scale index are at zero and deflection drum at 100.

(b) Axis of auxiliary collimator is in a plane parallel with line of fire under the same conditions.

(c) Angle of site level gives exactly the angle formed by axis of gun and a horizontal line when range is at zero.

(2) Before making the verification it is necessary to ascertain the trunnion "friction angle" to see that the trunnions are not prevented from rotating smoothly. If they do not work properly the rocker may be strained slightly and the sight bracket will not follow the movements of the gun promptly. See that rocker arms do not bind on the sides of the cradle.

(a) Set range at about 1,000 meters and angle of site at zero. These are the most desirable conditions, but range and angle of site can be at any graduation as long as these graduations are not changed during the operation.

(b) Center angle of site level bubble by slowly turning angle of site handwheel so as to depress the gun, being careful not to let bubble pass center of the level. In case bubble should pass center of the level, the breech must be completely lowered and the operations begun again.

(c) With level bubble centered place gunner's quadrant on leveling plates and read angle made by the gun with the horizontal. Leaving gunner's quadrant in place, give the handwheel two or three more turns so as to continue to depress the gun. Then reverse its motion and slowly elevate the gun until level bubble is again centered. Measure new angle of elevation. The difference between the two readings is the angular amount of lost motion in the trunnions and rocker.

(d) If lost motion or "friction angle" is less than $\frac{1}{2}$ mil, conditions are good. They are acceptable if it does not exceed 1 mil. It should never be above 1 mil. If the friction angle is above 1 mil, trunnions and trunnion caps should be examined and an attempt made to remedy the defect as prescribed in cleaning and oiling of these parts.

(e) If it is impossible to bring the friction angle below 1 mil, it is useless to proceed further with the verification of the sight, and the ordnance maintenance company should be notified.

(3) To verify angle of site level, set range and angle of site each at zero. Center level bubble by elevating the gun using angle of site handwheel on gun carriage. Place gunner's quadrant on breech and read angle. Then, after elevating the gun farther, again center level bubble by depressing gun and read angle with gunner's quadrant. Take the mean of the two angles. Repeat the operations after replacing the angle of site level with the spare level. If the gun is in normal condition and levels in good condition, all angles will be close to zero. In no case should the mean of the readings made with each level be more than 1 mil from zero. If angle of site

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level does not meet the above prescribed test, it should be sent to the ordnance maintenance company for repair.

(4) *To verify sight using the testing target and bore sights.*—When time and facilities are available, a firm and properly leveled platform for the carriage can be prepared. Method of testing is as follows:

(a) Place carriage so that wheels and trail are resting on level ground.

(b) Traverse carriage to one side and place gunner's quadrant on axle. Block either wheel if necessary to level carriage transversely, and set brake.

(c) Insert breech bore sight in shell chamber, being sure it is perpendicular to axis of bore. Place muzzle bore sight cord in the lines and attach the belt.

(d) By means of elevating mechanism depress gun slowly until zero mark of range scale is opposite index on rear guide. Care should be taken not to pass the mark. If zero mark is passed, elevate gun again and proceed as before until zero mark is reached. The object of this is to take up all lost motion and friction in one direction.

(e) Place gunner's quadrant on leveling plates.

(f) By means of angle of site mechanism depress the gun slowly, centering level bubble. Care should be taken not to let bubble pass beyond center of the quadrant level.

(g) By means of traversing mechanism place carriage near center of axle.

(h) Place sight in its bracket, care being taken that it is seated properly. Be sure that sight and bracket are clean and free from dirt or grit. Set the azimuth (plateau) scale to zero and the deflection (drum) scale to 100.

(i) Place the testing target at a distance of about 50 yards in a plane perpendicular to the bore of the gun and at such a height that the axis of the bore passes through the center of the target marked "bore". The target can be hung vertically and checked by means of a plumb bob. The target is moved until the vertical line through the targets on the right coincide with the plumb bob line. Raise or lower and move the target right or left until the axis of the bore sights coincide with the corresponding mark on the target. Do not release the carriage brakes to bring about coincidence.

(j) The collimator cross lines should fall on the point on the target marked "Sight, M1901". If the vertical axis of the collimator falls to either the right or left of the vertical line of the target, it indicates that the deflection index is out of adjustment. If the horizontal axis of the collimator falls on the target above or below the horizontal

line, it indicates that the bracket is out of adjustment. All adjustments necessary must be performed by the ordnance maintenance company.

(5) *To verify sight without testing target.*—(a) To verify the sight for elevation proceed as follows:

1. Place carriage on level ground. Traverse carriage to one side and place gunner's quadrant on axle. Block up either wheel if necessary to level the gun.
2. Set range at zero. Point the gun by means of the bore sights at a sharply defined object not less than 1,000 meters distant and determine angle of elevation by means of gunner's quadrant placed on breech.
3. Aim collimator in elevation on the same object by means of the cross lines, first elevating gun and then depressing it. Determine angle of elevation of the gun each time by means of gunner's quadrant and take the average of the two readings.
4. If all parts are properly adjusted and in good condition, all the angles thus determined will be approximately equal. If any difference exists, the average of the two readings with the sight should not differ from the reading with the bore sights (first obtained) by more than 1 mil.

(b) To verify the sight for direction proceed as follows:

1. Place the gun in the middle of its slides. Force a screw driver between sweeper plate and wall of slide; force the gun to opposite wall; make a fine vertical mark across front of sweeper plate and front of cradle. Force the gun on opposite side with a screw driver. If mark on sweeper plate does not agree with that of the cradle, move the gun toward the middle by half the distance between the two marks.
2. Aim by means of bore sights on a sharply defined point at least 1,000 meters distant.
3. Aim on the same point by means of the sight with azimuth (plateau) scale set at zero, taking care to turn deflection knob (drum) only so as to increase the deflection. Note graduation indicated by drum. Aim again by turning deflection knob (drum) so as to decrease the deflection. Note new indication. In the first case start from drum graduation 0 and in the second case from graduation 200.

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4. The difference between the two noted divisions must not exceed 5 mils, and both should be between the marks 96 and 104 on deflection drum.

5. Repeat the same operation with auxiliary collimator.

d. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) Avoid striking or bumping any part of the instrument, particularly the locating surfaces of the levels, extension, and sight mount socket which should also be kept clean, free from grit, and lightly coated with petrolatum.

(3) Periodically, oil sight mount using oil, lubricating, for aircraft instruments and machine guns. Five oil holes with swinging covers are provided for this purpose, designated by numbers 20 to 24, inclusive. Turn deflection knob as required to provide access to each of the two oil holes served by oil hole 21. Apply a few drops of oil occasionally on shank above the azimuth scale, at the same time pressing down on shank and turning it slowly.

e. Accessories and spare parts.—The carrying case for the collimating sight also contains space for a gunner's quadrant. The extension has a separate carrying case. A cover for the sight mount is provided. Spare parts consisting of a collimating sight, level, auxiliary level, and carrying case are provided. Parts of these sights are not interchangeable with similar parts of sights of different serial number and care must be taken that all parts pertaining to one serial number are kept together.

51. Target, testing.—A testing target is used during the bore sighting operation for the alinement of sights and subcaliber equipment with the axis of the bore of the piece. Four targets in an envelope are provided with each weapon. The aiming points corresponding to the axis of bore, subcaliber bore, and the lines of sight of such sighting equipment as may be applicable are plainly designated. It is essential that proper aiming points be selected for the matériel and equipment employed, and that the target be positioned vertically when in use.

SECTION II**FIRE-CONTROL EQUIPMENT****Paragraph**

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52. Circles, aiming.—*a. General.*—These instruments are for measuring lateral and vertical angles and for general topographical work.

b. M1916 and M1916MI.—(1) *Description.*—These two aiming circles (fig. 48) are of different manufacture but are similar in construction except for minor design features. Each instrument includes a 4.2-power fixed focus telescope with a laterally and vertically graduated reticle, a circular level, a declinometer, elevating, orienting, angle of site and azimuth mechanisms, and azimuth and elevation scales and micrometers. The instrument is furnished complete with tripod, stand, and two carrying cases.

(2) *Operation.*—(a) To set up the instrument, clamp tripod legs at desired length, embed them firmly in the ground and tighten leg clamping levers. Place aiming circle on mount, level by means of ball-and-socket joint and circular level, and clamp joint when level bubble is centered. Swing shutter over telescope objective up so that the opening therein is in direction of line of sight.

(b) To orient the instrument, either a datum point of known azimuth or magnetic bearings may be used.

1. To orient on a datum point of known azimuth, set azimuth scale (100-mil steps) and micrometer (1-mil steps) to azimuth of datum point and turn orienting knob. For large angular changes, relocate instrument on spindle, using orienting clamping wing nut, until datum point appears on vertical cross line of reticle. The telescope may be elevated or depressed as required to bring point in field of view.
2. To orient on magnetic north, set azimuth scale (100-mil steps) and micrometer (1-mil steps) to indicate zero. Press needle release plunger and hold in place with catch provided. Turn orienting knob. For large angular changes relocate instrument on spindle, using orienting clamping wing nut, until arrow index lines of declinometer are approximately aligned with magnetic needle. Then bring south-seeking end of needle midway between parallel lines of mirror index. The instrument will then indicate magnetic azimuth.
3. To orient on grid north, proceed as for magnetic north but set azimuth to magnetic declination of the locality (subtracting west declinations from 6,400 mils) instead of to zero. When needle is aligned with mirror index, the north end will point to east or west side of the N index mark,

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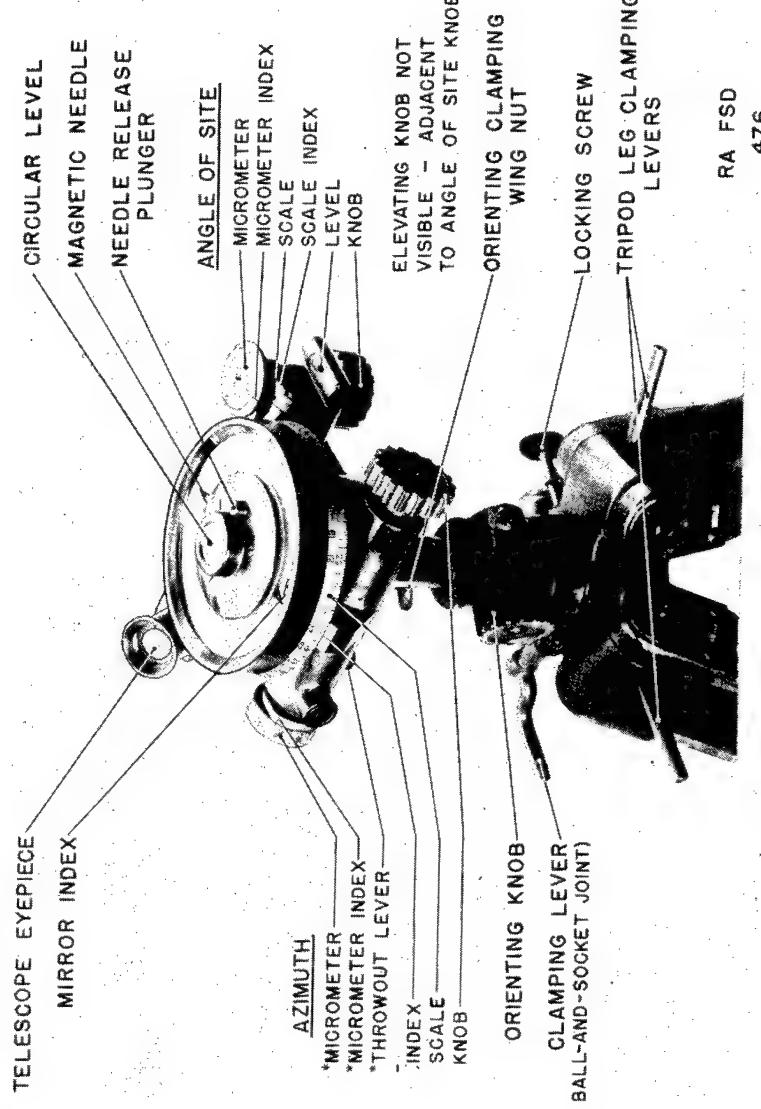


FIGURE 48.—Aiming circle, M1916.

NOTE.—Aiming circle, M1916MI, is similar in appearance but parts indicated by an asterisk (*) are on the same end of the shaft as the knob.

depending on whether declination is east or west. The instrument will then indicate grid azimuths.

4. When orientation by magnetic bearings has been completed, remove catch from needle release plunger, clamping needle.

(c) To read angle of site, rotate elevating knob so that object appears on horizontal cross line of reticle and then center bubble of angle of site level, using angle of site knob. The angle of site will then be indicated on angle of site scale (100-mil steps) and micrometer (1-mil steps). An indication of 300 mils corresponds to a horizontal line of sight. The graduations along vertical line of reticle are spaced at 5-mil intervals and may also be used for measurement of angle of site up to ± 85 mils. To make the 0 graduation correspond to a level line of sight, set angle of site scale and micrometer to normal (300 mils) and elevate or depress telescope to center level bubble.

(d) To read azimuth, bring object on vertical cross line of reticle using azimuth knob. The throw-out lever may be depressed to permit making large angular changes rapidly. Azimuth is then indicated on azimuth scale (100-mil steps) and micrometer (1-mil steps). For azimuths in the 3,200- to 6,400-mil region an auxiliary (upper) set of graduations on the scale is provided, indications thereon corresponding to those on panoramic telescopes with 0-3,200, 0-3,200 azimuth scales. Small angles may also be measured along the horizontal cross line of the reticle which is graduated at 5-mil intervals.

(e) For use in darkness, a window is provided near the eyepiece of the telescope to be illuminated by external means not furnished with the instrument.

(f) To prepare instrument for traveling, swing down shutter over telescope objective. Be sure magnetic needle is clamped. Release orienting clamping knob. Remove aiming circle from mount and place it in carrying case. Do not remove mount from tripod.

(g) To use instrument in connection with a plotting board, place it on the stand provided instead of on the tripod. The stand has a fiducial edge permitting use of the aiming circle as an alidade.

(3) *Test and adjustment.*—(a) The azimuth scale and micrometer should indicate zero simultaneously. To make this adjustment, loosen the retaining screw in end of shaft, slip micrometer around as required, then tighten screw.

(b) Angle of site indication may be verified by sighting on a distant point at the same level as the telescope or at some other known angle. If the error is small, a correction may be applied by loosening retaining screw and slipping angle of site micrometer through required

angle, then tightening screw. If angle of site scale and micrometer do not then read zero simultaneously, instrument should be turned in for adjustment.

(c) To check declinometer it is necessary to set the instrument up in a position not subject to local magnetic attraction and sight on one or (preferably) more points of known azimuth. The average error should be noted and record made of necessary correction to be applied to future readings. No adjustment by the using arm is permitted.

(d) Ball-and-socket joint of mount should have a snug friction fit when the associated clamping lever is released. Excessive tightness or lost motion may be adjusted by means of the plug in the center of bottom of mount. This plug is locked by the retaining ring concentric therewith, which must be loosened for adjusting. Tighten retaining ring securely when adjustment is completed.

c. *M1918 (French).*—(1) *Description.*—(a) This instrument (figs. 49 and 50) includes a four-power telescope with a laterally and vertically graduated reticle, two levels, a declinometer, elevating, orienting, and azimuth mechanisms, and azimuth scales and micrometers indicating both in mils and in drum and plateau settings of the French sight, M1901. No scale other than that on the reticle is provided for vertical angles.

(b) Instrument is furnished complete with tripod and carrying case.

(c) Aiming circles, M1918, are being equipped with instrument light, M4. This instrument light includes a battery case containing a single flashlight cell connected by flexible cords to a finger light and to a lamp housing which is arranged to be clamped to the aiming circle telescope for reticle illumination. The aiming circle carrying case is being modified to provide space for carrying the instrument light.

(2) *Operation.*—(a) To set up instrument, clamp tripod legs at desired length and embed them firmly in the ground. Clamp sliding support of tripod at desired height by means of clamping screw in tripod head. Level instrument, using circular level and ball-and-socket joint. Focus telescope as required, using focusing ring on eyepiece.

(b) To orient instrument, either a datum point of known azimuth or magnetic bearings may be used.

1. To orient on a datum point of known azimuth, set azimuth scale (100-mil steps) and micrometer (1-mil steps) to azimuth of datum point and turn one of the orienting

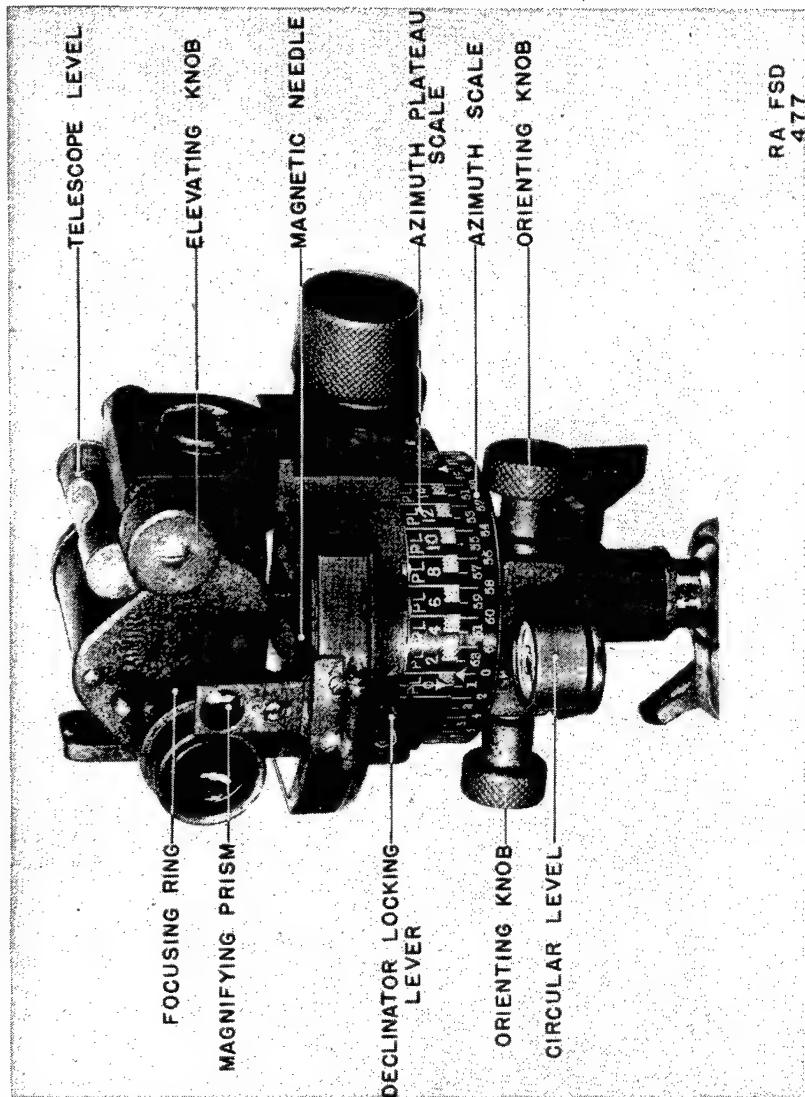


FIGURE 49.—Aiming circle, M1918 (French), rear view.

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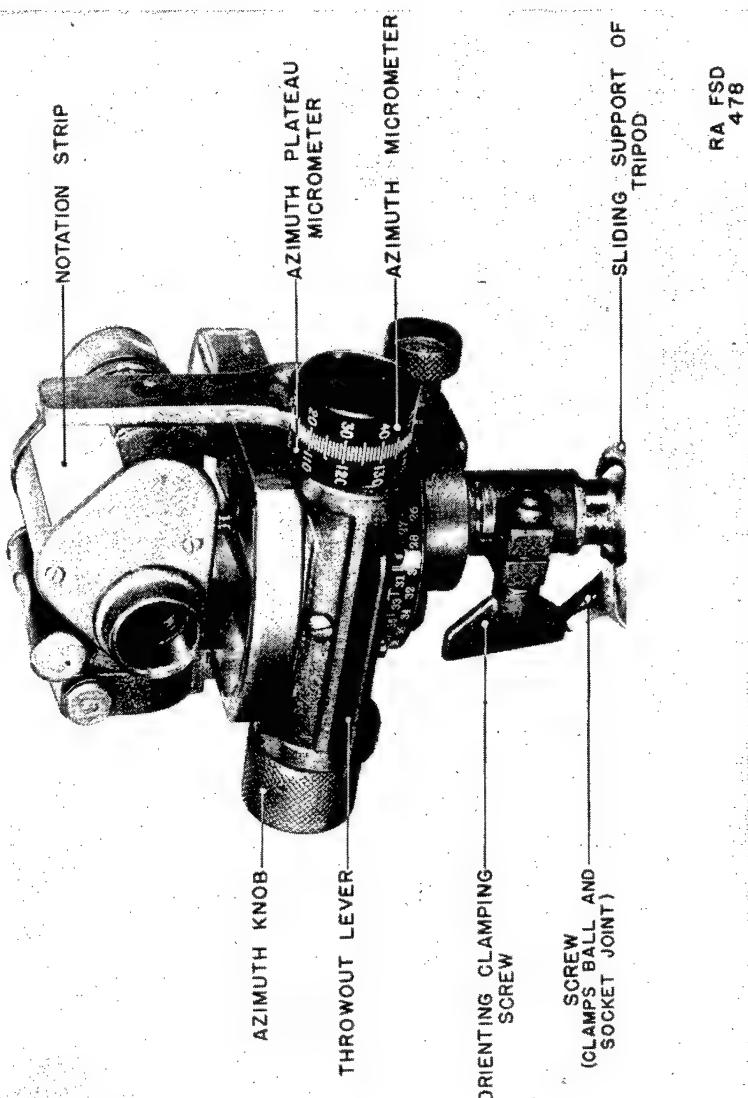


FIGURE 50.—Aiming circle, M1918 (French), front view.

knobs. The instrument may also be relocated on tripod spindle, using orienting clamping screw for large angular changes, until datum point appears on vertical cross line of reticle. The telescope may be elevated or depressed as required to bring point in field of view.

2. To orient on magnetic north, set azimuth scale lever to permit to indicate zero. Rotate declinometer locking lever to permit magnetic needle to swing free. Turn one of the orienting knobs. The instrument may also be relocated on tripod spindle using orienting clamping screw for large angular changes so that the south-seeking end of the magnetic needle is in exact alinement with rear index of declinometer as viewed through magnifying prism. Instrument will then indicate magnetic azimuths.
3. To orient on grid north, proceed as for magnetic north but set azimuth to magnetic declination of the locality (subtracting west declinations from 6,400 mils) instead of to zero. Instrument will then indicate grid azimuth.
4. When orientation by magnetic bearings has been completed, clamp needle by means of declinometer locking lever.

(c) To read angle of site, rotate elevating knob so that bubble of telescope level is centered. The angle of site of an object is then indicated by its position on the graduations at 5-mil intervals along vertical cross line of reticle. Angles of site thus measured are limited to ± 100 mils and no other indicating means are provided.

(d) To read azimuth, bring object on vertical cross line of reticle using azimuth knob. The throw-out lever may be depressed for making large azimuth changes rapidly.

1. Azimuth indication of this instrument may be read either directly in mils or in terms of indications on the French sight, M1901. Azimuths in mils are read directly on the azimuth scale (100-mil steps) and micrometer (1-mil steps).
2. Indications corresponding to those on the French sight (four 0-1,600 mil quadrants graduated in 200-mil steps) are read on the azimuth plateau scale, read opposite one of the four index marks (at 0, 16, 32, and 48 graduations of azimuth scale). Only the even-numbered graduations on the azimuth plateau scale are read. Supplementary indications are the same as read on the deflection scale (drum) of the sight. When the index points into a clear space on the azimuth plateau scale, the supplementary indication is read on the azimuth micrometer (0-100 mils). When the index

points into a cross-hatched space on that scale, the supplementary indication is read on the azimuth plateau micrometer. The two micrometers are read opposite different indexes. The azimuth plateau micrometer (upper) index bears cross hatching for ready identification.

3. Small angles may also be measured along the horizontal cross line of the reticle which is graduated at 5-mil intervals.

(e) To prepare instrument for traveling, loosen ball-and-socket joint and place instrument in carrying case provided. Do not remove instrument from tripod.

(3) *Test and adjustment.*—(a) Azimuth and plateau micrometers should read 0 and 100, respectively, when azimuth scale indicates zero. The screw in end of micrometer shaft may be loosened for this adjustment.

(b) The telescope level should indicate the line of sight determined by center of reticle to be horizontal. This may be verified by sighting on a distant point at the same level as the telescope, the error, if any, being read on the reticle. No corrective adjustment by using arm is permitted. A celluloid notation strip is provided on the telescope on which any correction should be recorded.

(c) To check accuracy of declinometer it is necessary to set instrument up in a position not subject to local magnetic attraction and sight on one or (preferably) more points of known azimuth. The average error should then be noted and necessary correction recorded on notation strip. No adjustment by using arm is permitted.

d. *M1.*—(1) *Description.*—(a) This instrument (fig. 51) includes a four-power telescope with a laterally and vertically graduated reticle, two levels, a declinometer, elevating, orienting, and azimuth mechanisms, and azimuth scales and micrometers indicating azimuths both in mils and in terms of scale indications on other instruments commonly used therewith. No scale other than that on reticle is provided for vertical angles.

(b) Instrument is furnished complete with tripod and carrying case.

(c) Aiming circles, M1, are being equipped with instrument light, M2, which includes a battery case connected by flexible cables to a reticle unit and to a finger light. The battery case, containing one flashlight cell, is arranged to be clamped to a tripod leg and has a switch controlling both lamps simultaneously. The reticle unit snaps in place in a dovetailed slot over the reticle illuminating window. The finger light has a soft rubber housing and is held by a spring clip on the battery case when not in use. The aiming circle carrying

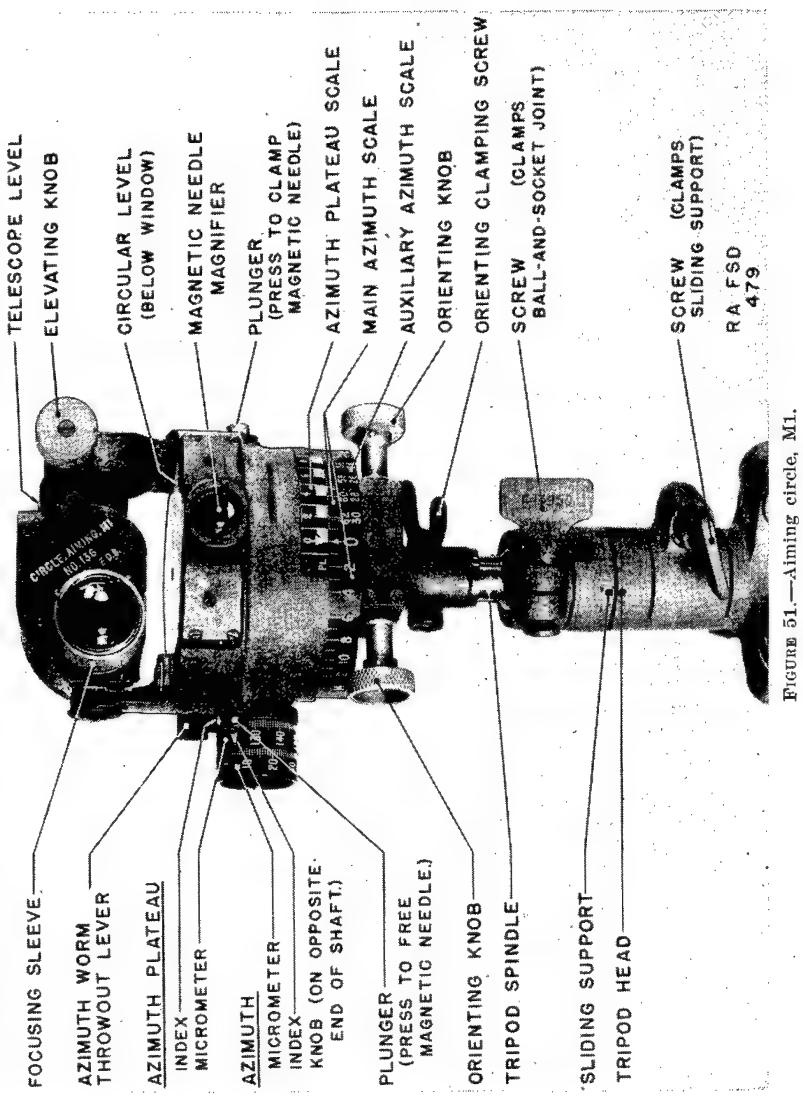


FIGURE 51.—Aiming circle, M1.

case is being modified to permit storage of the flashlight cell separately from the battery case.

(2) *Operation.*—(a) To set up instrument, clamp tripod legs at desired length and embed them firmly in the ground. Clamp sliding support of tripod at desired height. Level instrument using circular level and ball-and-socket joint. Focus telescope as required, using sleeve on eyepiece.

(b) To orient the instrument, either a datum point of known azimuth or magnetic bearings may be used.

1. To orient on a datum point of known azimuth, set main azimuth scale (100-mil steps) and micrometer (1-mil steps) to azimuth of datum point and turn one of the orienting knobs. The instrument may also be relocated on tripod spindle using orienting clamping screw for large angular changes until datum point appears on vertical cross line of reticle. The telescope may be elevated or depressed as required to bring point in field of view.

2. To orient on magnetic north, set main azimuth scale and micrometer to indicate zero. Press plunger releasing magnetic needle and turn one of the orienting knobs. The instrument may also be relocated on tripod spindle using the orienting clamping screw for large angular changes until the north-seeking (knife-edge) end of magnetic needle appears approximately opposite an index behind the letter N at front of instrument. Then refine setting so that the south-seeking (rectangular) end of needle is centered in reticle, viewed through the magnifier. Instrument will then indicate magnetic azimuths.

3. To orient on grid north, proceed as for magnetic north but set azimuth to magnetic declination of the locality (subtracting west declinations from 6,400 mils) instead of to zero. Instrument will then indicate grid azimuths.

4. When orientation by magnetic bearings has been completed, press the red plunger to clamp the magnetic needle.

(c) To read angle of site, rotate elevating knob so that bubble of telescope level is centered. The angle of site of an object is then indicated by its position on the graduations at 5-mil intervals along vertical cross line of reticle. Angles of site thus measured are limited to ± 85 mils and no other indicating means are provided.

(d) To read azimuth, bring the object on vertical cross line of reticle using azimuth knob. The throw-out lever may be depressed for making large azimuth changes rapidly. Azimuth indications of

this instrument may be read either directly in mils or in terms of indications of other instruments commonly used in connection therewith.

1. Azimuths in mils are read directly on the azimuth scale, using the main (upper) graduations for values from 3,200 mils up. Indications on this scale are at 100-mil intervals and are supplemented by those on the azimuth micrometer which is graduated at 1-mil intervals.
2. Angular indications corresponding to those on panoramic telescopes with 0-3,200,0-3,200 mil scales are similarly read, auxiliary (lower) graduations for azimuths over 3,200 mils.
3. Angular indications corresponding to those on the French sight, M1901 (four 0-1,600 mil quadrants graduated in 200-mil steps), may also be read, using azimuth plateau scale, read opposite one of the four index marks (at 0, 16, 32, and 48 graduations of azimuth scale). Only even-numbered graduations on azimuth plateau scale are read. Supplementary indications are the same as read on the deflection scale (drum) of the sight. When index points into a cross-hatched space on azimuth plateau scale, the supplementary indication is read on the azimuth micrometer (0-100 mils). When index points into a clear space, the supplementary indication is read on the azimuth plateau micrometer (100-200 mils).
4. Small angles may also be measured along horizontal cross line of reticle which is graduated at 5-mil intervals.

(e) To prepare instrument for traveling, loosen ball-and-socket joint and place instrument in its carrying case. Do not remove instrument from the tripod.

(3) *Test and adjustment.*—(a) Azimuth and plateau micrometers should read 0 and 100, respectively, when azimuth scale indicates zero. Three screws in end of azimuth micrometer may be temporarily loosened for this adjustment.

(b) The telescope level should indicate line of sight determined by center of reticle to be horizontal. This may be verified by sighting on a distant point at the same level as the telescope, the error, if any, being read on the reticle. No corrective adjustment by the using arm is permitted. A celluloid strip is provided on the front of the instrument on which any correction should be recorded.

(c) To check accuracy of declinometer it is necessary to set instrument up in a position not subject to local magnetic attraction and sight on one or (preferably) more points of known azimuth. The

average error should be noted and necessary correction recorded on celluloid strip. No adjustment by the using arm is permitted.

e. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) Exposed moving parts should be oiled occasionally with a small quantity of neutral oil (or oil, lubricating, for aircraft instruments and machine guns for temperatures below 32° F.). Interior parts are not to be lubricated. Wipe off excessive lubricant to prevent accumulation of dust and grit.

(3) When storing aiming circles equipped with instrument lights, remove flashlight cell from battery case and place it in the compartment of the aiming circle carrying case.

53. Compass, prismatic, M1918 (Sperry).—This instrument (fig. 52) is used for measuring angles of site, clinometer angles, and magnetic azimuths.

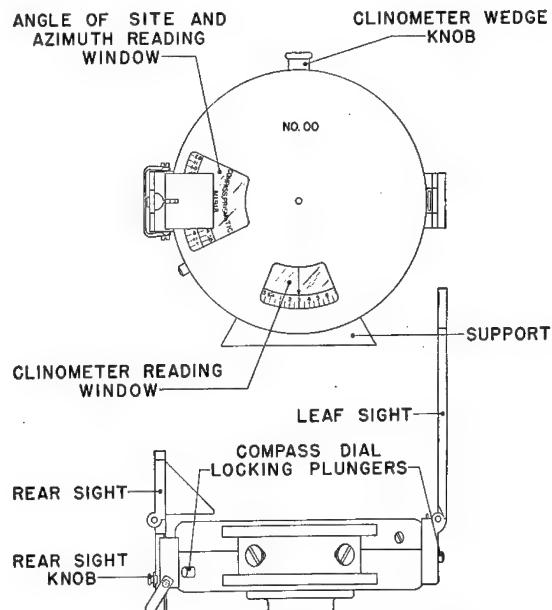


FIGURE 52.—Prismatic compass, M1918 (Sperry).

a. Description.—This instrument is furnished complete with a carrying case but without tripod. The instrument includes a compass dial (green) carrying a magnetic needle and azimuth scales, a weighted clinometer dial (white), and a sighting system whereby angular indications may be read while observing the object.

b. Operation.—(1) To measure angles of site, raise leaf sight and rear sight. Pull out clinometer wedge knob to permit free rotation of clinometer dial. Focus rear sight on clinometer (white) dial, sliding sight as required and clamping it in position with rear sight knob. Hold instrument with dials in a vertical plane, look through niche in rear sight, and elevate or depress instrument until object observed is in line with horizontal central vane of leaf sight. The angle of site, reflected in rear sight prism, will also be visible in the center of the field of view. The angle of site scale (outer scale on clinometer dial) is graduated at 5-mil intervals and numbered at 100-mil intervals. The 50-mil points are also marked. A 300-mil indication corresponds to a level line of sight, as on the corresponding scales of range quadrants. The clinometer wedge knob may be partially depressed to damp out oscillations. It must not be depressed when taking the reading.

(2) To measure azimuths, first operate the instrument in angle of site until the compass (green) dial is exposed at rear sight by cut-away portion of clinometer (white) dial. Depress clinometer wedge knob. Raise leaf sight and rear sight. Focus rear sight on compass (green) dial, sliding sight as required and clamping it in position with rear sight knob. Hold instrument in hand or support it on a convenient nonmagnetic body. Look through niche in rear sight and rotate instrument in azimuth until the object observed is in line with the vertical ventral vane of the leaf sight. The magnetic azimuth, reflected in rear sight prism, will also be visible in the center of the field of view. The compass dial is graduated at 10-mil intervals and numbered at 100-mil intervals. Additional numbering is provided in the 3,200-6,400 mil half of the scale to correspond to the numbering on azimuth scales of panoramic telescopes which are graduated 0-3,200 mils in this range. To damp out oscillations of compass dial, gently depress one of the locking plungers. Plungers must not be in depressed position when taking the azimuth reading.

(3) To use the instrument as a clinometer, pull out clinometer wedge knob and stand instrument, prism to the rear, on its support, on a straight portion of the piece which is parallel to the bore. The reading of clinometer scale, read opposite an etched line on clinometer reading window, is the elevation of the piece. The clinometer scale is graduated at 10-mil intervals and numbered at 100-mil intervals. A 300-mil reading indicates bore of the piece to be level. Sights should not be raised when using instrument only as a clinometer. The clinometer wedge knob may be partially depressed to damp out oscillations. It must not be depressed when taking the reading.

(4) To prepare instrument for traveling, push in clinometer wedge knob (clamping clinometer dial) and turn leaf sight down (clamping the compass dial). Lower and fold back rear sight, securing it in place with the catch. Place instrument in case provided.

c. Test and adjustment.—Accuracy of azimuth and angle of site indications may be checked by sighting on datum points of known azimuth and elevation. When placed on a flat level surface the clinometer should indicate 300. No adjustment by the using arm is permitted.

d. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) When not in use keep leaf sight down clamping compass dial, and clinometer wedge knob depressed clamping clinometer dial, thus preventing injury to and excessive wear of their respective pivots.

(3) Observe particular care to prevent bending of the leaf sight parts.

(4) No lubrication of the instrument is required.

54. Finder, range, 1-m base, M1916.—This instrument (figs. 53 and 54) is used primarily for measuring distance by triangulation. Indications of azimuth and angle of site are also provided.

a. Description.—The instrument includes an internal 1-meter base line, a 15-power optical system with two objectives and a common eyepiece of the coincidence type, and a scale on which the distance is indicated. It is furnished complete with mount and tripod. Necessary carrying cases and adjusting equipment are provided as accessories. The mount positions the line of sight of the range finder in elevation and azimuth and provides a hinge joint for placing the base line axis of the instrument in either a vertical or horizontal position. Angle of site and azimuth scales and micrometers are provided on the mount.

b. Operation.—(1) To set up the instrument, securely clamp tripod legs at desired length, embed them firmly in the ground, and tighten leg clamping levers. It is necessary that azimuth scale is in a substantially horizontal plane. Place range finder on mount and latch it in position. Position longitudinal axis horizontally and clamp with hinge clamping handle. Procedure for a vertical base line is described in (5) below.

(2) To prepare optical system for use rotate end box sleeves, uncovering both windows. Set ray filter lever to proper position. No filter at all may be used, or the amber filter (for exceptionally bright daylight or reflection of sun over water), or the smoked

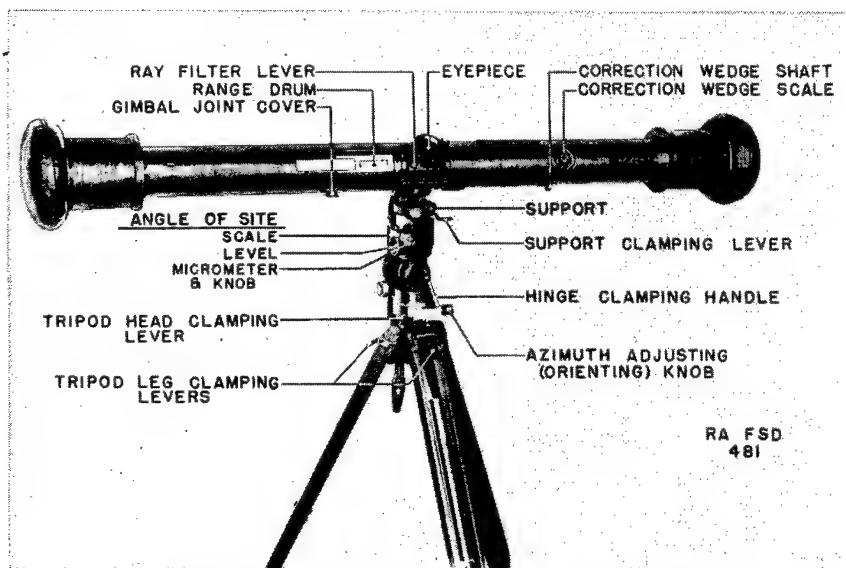


FIGURE 53.—Range finder, M1916, 1-m base, rear view.

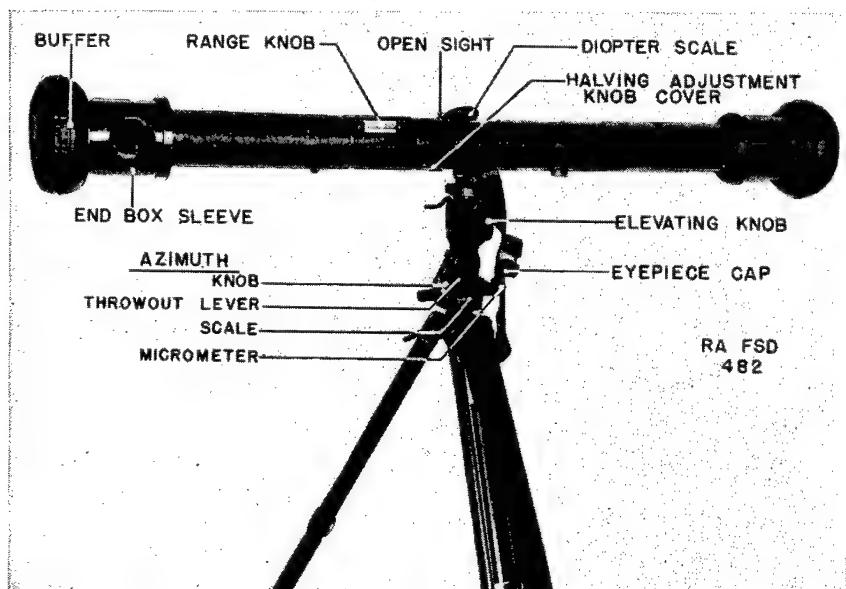
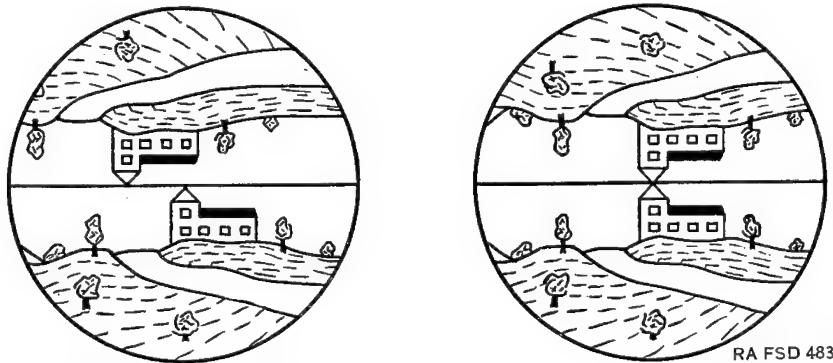


FIGURE 54.—Range finder, M1916, 1-m base, front view.

filter (for observation near the sun or into direct rays of a search-light) may be employed. Focus eyepiece by rotating diopter scale to produce a clear image. If the operator knows the value for his own eye, the setting may be made directly on the scale.

(3) To orient the instrument, select a datum point of known azimuth. Set this value on azimuth scale and micrometer. Loosen tripod head clamping lever and swing instrument until datum point appears near vertical center line of field of view, indicated by a short line in lower field of view. Clamp lever and refine setting with azimuth adjusting (orienting) knob so that point appears exactly on vertical center line.

(4) To measure the range of an object, select a clearly defined part perpendicular, if possible, to the halving line. Move the instrument in azimuth and elevation as required to bring the part at center of field of view when in coincidence. On moving targets it is advisable to start with the target at edge of field of view so that it may be brought into coincidence as it crosses the field. An open sight is provided for picking up the target. For large angular displacements in azimuth, depress throw-out lever and turn instrument as required. When first observed images will ordinarily not be in coincidence (fig. 55①). Turn range knob until images of point selected appear in coincidence (fig. 55②). Read range in yards on range drum opposite sliding range pointer.



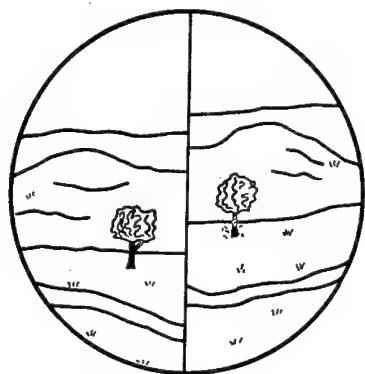
① Not in coincidence.

② In coincidence.

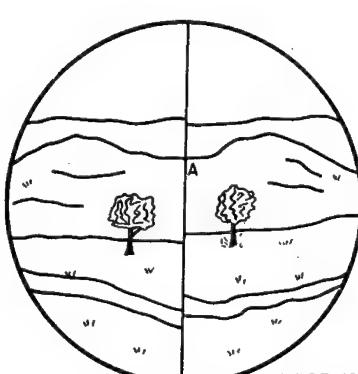
FIGURE 55.—Range finder field of view, horizontal base.

(5) To measure range of horizontal objects such as roads, trenches, crests of ridges, etc., which have no prominent vertical parts, turn instrument with longitudinal axis vertical, temporarily loosening hinge clamping handle for the purpose. Images when first observed

will ordinarily not be in coincidence (fig. 56①). Turn the range knob until the image of horizontal line appears to continue across the halving line as at A in figure 56②. Temporarily lower the support clamping lever for any necessary motion in elevation (within limits of $\pm 10^\circ$).



① Not in coincidence.



② In coincidence at A.

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FIGURE 56.—Range finder field of view, vertical base.

(6) To read angle of site, center level bubble using angle of site knob. The angle of site indication may then be read on associated scale (100-mil steps) and micrometer (1-mil steps). An indication of 300 mils corresponds to a horizontal line of sight. Angle of site can be read only when using the instrument with longitudinal axis horizontal.

(7) To read azimuth, the azimuth scale (100-mil steps) and micrometer (1-mil steps) furnish the necessary indications. It is essential that the plane of the azimuth scale be substantially level and that the object be at the center of field of view for correct angular indications. Azimuth may be measured with longitudinal axis either vertical or horizontal, but the instrument must be oriented separately for each position. Azimuths from 3,200 to 6,400 mils have an additional auxiliary scale reading from 0 to 3,200 mils for use with panoramic telescopes similarly graduated.

(8) To prepare instrument for traveling, cover the eyepiece, close the end box sleeves and the cover over range drum. Remove range finder from mount and place in its case. Place mount and tripod in their case, with elevating knob toward inside of case. Do not remove mount from tripod. Remove sight from adjusting lath. Place lath in internal pocket of tripod carrying case and sight in lid

pocket. The latter pocket also contains the correction wedge key and a camel's-hair brush.

c. *Test and adjustment.*—(1) *Halving line.*—Incorrect adjustment of the halving line is indicated by failure of the corresponding points on inverted and erect images to fall on the halving line (fig. 57). To

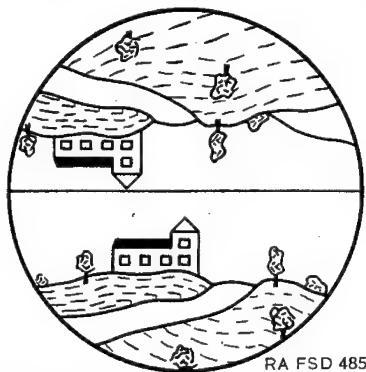


FIGURE 57.—Range finder field of view, incorrect halving.

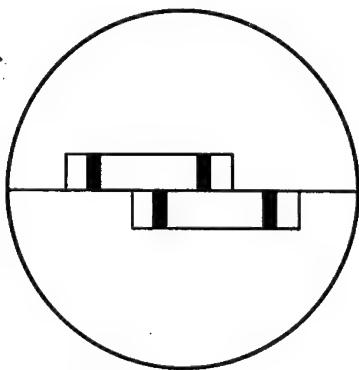
correct the halving, slide back cover exposing the halving adjustment knob and rotate knob until the corresponding point on each image touches the halving line (as in fig. 55① and ②). A sharply defined point at least 400 yards away must be used for this adjustment. Return cover to its original position when adjustment is completed.

(2) *Range indication.*—(a) To test the instrument using a finite range, select a sharply defined object at a distance of 400 yards or more, the range of which is accurately known, and bring the object into coincidence in the center of field of view (fig. 55②). If range adjustment is correct, the known range should be indicated.

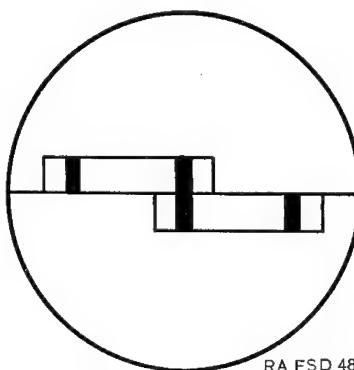
(b) To test using moon or other celestial body (never the sun), proceed as for an object at finite range. Infinite range (∞) should be indicated.

(c) To test the instrument by the infinity method, prepare adjusting lath by inserting the sight (carried in pocket flap of carrying case). Place adjusting lath in a horizontal position 200 yards or more from the instrument. Use the sight on the lath to insure perpendicularity to line of sight. Set range drum to indicate infinite range (∞). If images appear alined as in figure 58②, the adjustment is correct. Misalinement such as is shown in figure 58① indicates necessity for adjustment.

(d) To adjust instrument in range, set range at the known range or at infinity, depending on the method of test employed, and bring images into correct relation using the correction wedge key to turn correction wedge shaft. Note indication on correction wedge scale, repeat several times, and set the scale to the average of the readings.



① Incorrect alignment.



② Correct alignment.

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FIGURE 58.—Range adjustment, infinity method.

(e) It is essential that the adjusting lath, when used, be the one belonging with the instrument. The same serial number is provided on both.

(3) *Azimuth indication.*—If azimuth scale and micrometer fail to indicate zero simultaneously, the latter may be slipped around as required, temporarily loosening clamping screw in the end.

(4) *Angle of site indication.*—Sight on a point at least 400 yards distant at the same level as the range finder. The angle of site indication should be normal (300 mils). Correction for small errors may be applied by slipping angle of site micrometer through required angle, temporarily loosening clamping screw in the end.

d. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) Gimbal joint cover is not to be removed by using arm.

(3) Keep cover over the halving adjustment knob closed except when making an adjustment.

(4) Range finder should not be pointed directly at the sun. This instrument contains a cemented prism which will be injured by such practice.

(5) Avoid striking or bumping the instrument at the ends when mounted as the parts at the center will thereby be subjected to excessive stress.

(6) Exposed moving parts of mount should be oiled occasionally using neutral oil for temperatures above 32° F. and oil, lubricating, for aircraft instruments and machine guns, for temperatures below 32° F. Interior parts of mount and range finder are not to be lubricated by using arm. Keep excess lubricant that seeps from the mechanism wiped off to prevent accumulation of dust and grit.

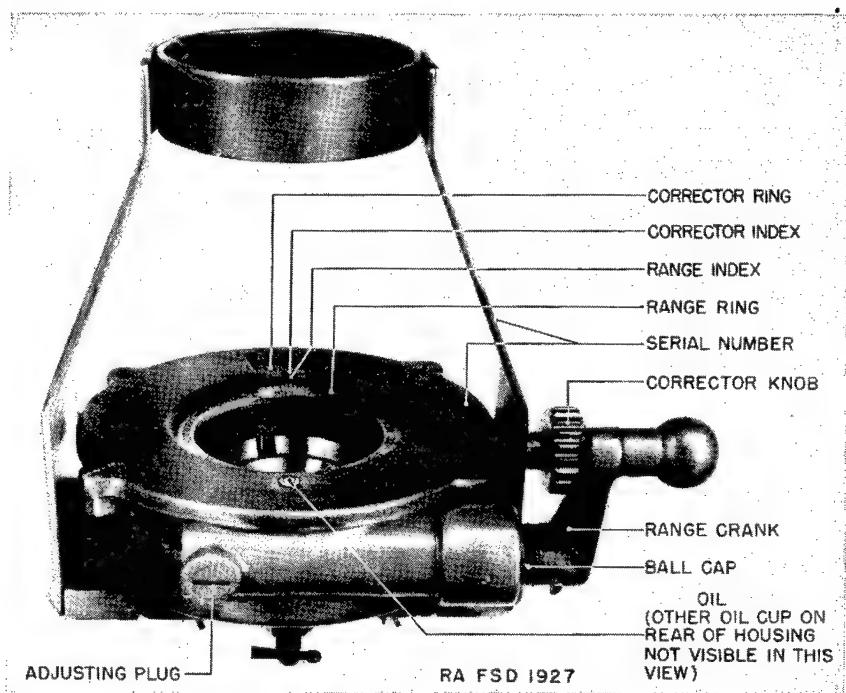


FIGURE 59.—Bracket fuze setter, M1916.

55. Setter, fuze, bracket, M1916.—This fuze setter (fig. 59) is used for setting the 21-second fuze, M1907M. It is furnished complete with cover.

a. *Operation.*—(1) Check to see that range ring corresponds to the gun and ammunition in use. This information is engraved on the range ring.

(2) Using the crank, set the desired value of range opposite range index. By means of corrector knob set desired value of corrector opposite corrector index. A setting of 30 corresponds to zero corrector.

(3) Insert round, fuze foremost, into the setter without regard to the relative position of fuze pins and setter parts. With round

pressed firmly into the setter, rotate the round manually in a *clockwise* direction until a stop is encountered.

(4) Leave the round in setter until ready for use. Range or corrector may be changed with the round in place, the round then being again turned clockwise as in the original setting operation. Remove the round when ready for use, being careful not to change the fuze setting.

(5) To set a fuze to safe, set range at S, corrector at 30, and proceed as for other settings.

b. Test and adjustment.—(1) Accuracy of a particular fuze setter may be determined as follows: Set corrector to 30 and range to any convenient value, and set a fuze. The time set on the fuze should agree with the firing-table time of flight for the particular range. Several ranges should be used and a mean error determined. A false corrector may be applied to reduce the error.

(2) The only adjustments permitted the using arm are as follows:

(a) To eliminate looseness in either worm gear, loosen set screw and turn adjusting plug clockwise. Retighten set screw. Range crank should not fall of its own weight.

(b) To eliminate end play in either worm shaft, remove range crank or corrector knob by driving out taper pin, loosen set screw, and tighten ball cap with a teat wrench. Retighten set screw. Replace range crank or corrector knob and taper pin.

c. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) For temperatures above 32° F., occasionally oil the mechanism with neutral oil in the two oil cups provided. For temperatures below 32° F., oil mechanism with oil, lubricating, for aircraft instruments and machine guns. Set range to zero when oiling.

(3) Rotate the round only in a clockwise direction. Incorrect settings and loosening of the fuze may result from failure to do so.

(4) If the setter becomes clogged with sand or dirt so as to affect its operation, it is to be turned over to qualified ordnance personnel for cleaning.

(5) When not in use, protect the setter with its cover.

56. Table, firing.—The firing table is a pamphlet presenting in tabular form the exterior ballistic data for a weapon and its ammunition.

57. Telescope, battery commander's, M1915.—This instrument (figs. 60 and 61) is a 10-power binocular instrument used for observation and for measurement of azimuth and angle of site.

a. Description.—(1) The instrument complete includes a binocular telescope, mount, tripod, and as accessories the necessary carrying cases, storage chest, and cleaning brushes.

(2) Modified instruments to be designated M1915A1, will be equipped for reticle illumination and will be designed to receive

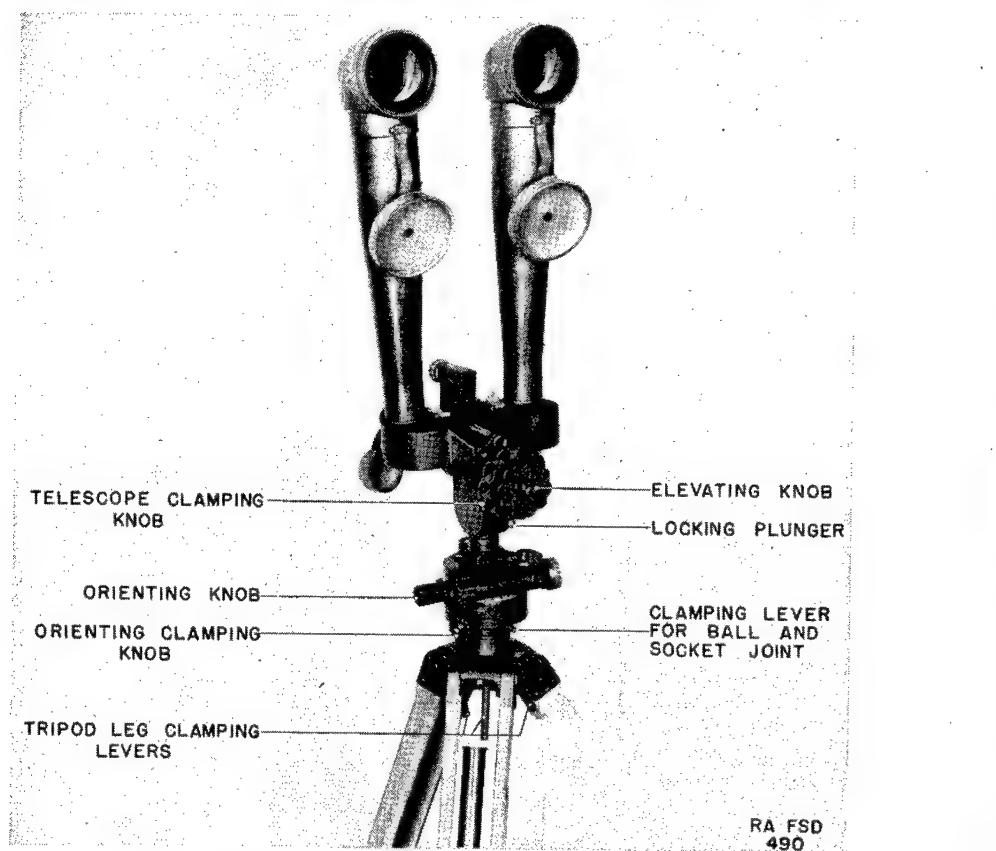


FIGURE 60.—Battery commander's telescope, M1915, front view.

the instrument light, M1. Illumination of such instruments may be supplied by flashlight until such time as the instrument light becomes available.

(3) Telescopes are arranged so that they may be positioned vertically, as shown, or swung down horizontally.

b. Operation.—(1) To set up the instrument, remove tripod and mount from tripod carrying case, clamp tripod legs at desired length, embed them firmly in the ground, and tighten leg clamping levers. Remove telescope from its carrying case and place it on

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the vertical spindle extending from the mount, depressing locking plunger and turning telescope until mating surfaces of telescope and mount engage properly, then releasing plunger. Level the mount using the circular level and ball-and-socket joint at bottom of mount, and clamp with the lever when level bubble is centered.

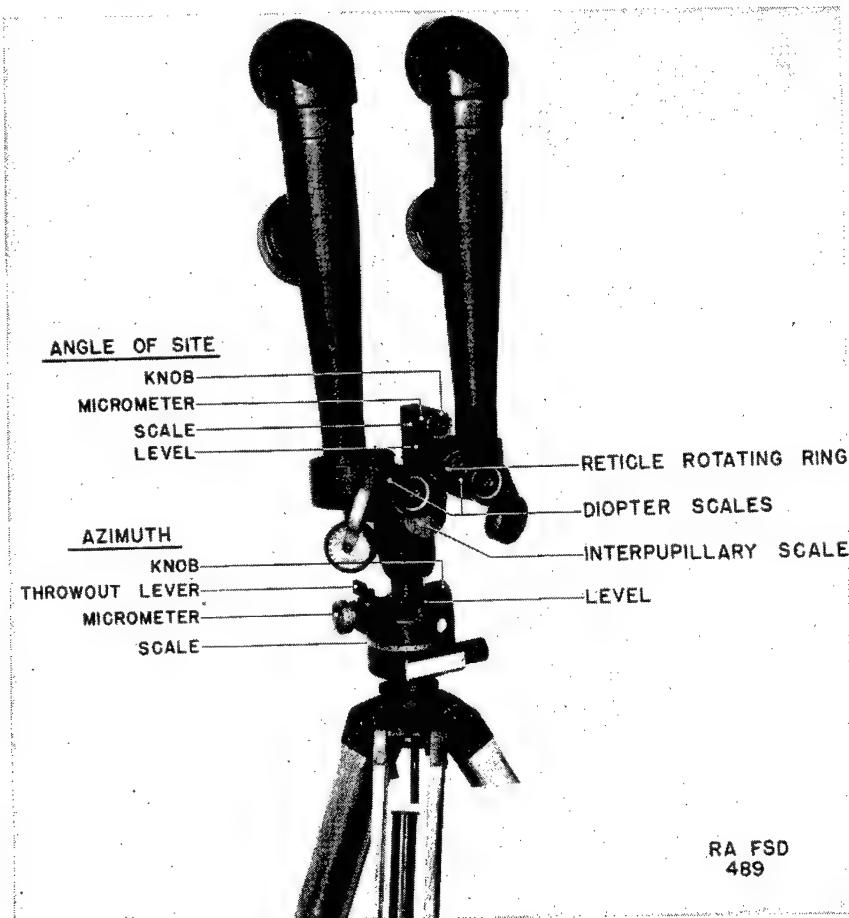


FIGURE 61.—Battery commander's telescope, M1915, rear view.

(2) To prepare the telescope, remove caps from eyepieces and objectives. If required, place sunshades over objectives and amber filters over eyelenses. Sunshades and filters are carried in compartments of the telescope case. Release telescope clamping knob and turn telescopes to vertical or horizontal position as required, at the same time setting proper interpupillary distance in millimeters

on associated scale, and clamp in place. If interpupillary distance for observer is not known it may be found by observing the sky and moving eyepieces apart or together until field of view changes from two overlapping circles to one sharply defined circle. Focus each eyepiece independently, looking through telescope with both eyes open at an object several hundred yards away, covering the front of one telescope and turning diopter scale until object appears sharply defined, then repeating for other eye. A diopter scale is provided for each eye and if observer remembers the values for his own eyes, settings may be made directly on the scales. Turn reticle rotating ring until reticle appears erect.

(3) To orient the instrument, select a datum point of known azimuth and set this value on azimuth scale (100-mil steps) and micrometer (1-mil steps). The throw-out lever may be used to disengage the worm drive for making large changes in azimuth rapidly. Turn telescope by means of orienting knob until datum point appears at the center of reticle of right hand telescope. The orienting clamping knob may be temporarily released for making large angular changes rapidly. Thereafter use only the azimuth knob or for large changes the azimuth throw-out lever, and correct azimuth of point observed will be indicated. For azimuths in the 3,200-6,400 mil region additional numbers (0-3,200 mils) are provided corresponding to azimuth scales on panoramic telescopes and other instruments.

(4) To read angle of site, swing angle of site mechanism into a substantially vertical plane. Direct telescope on the object and rotate elevating knob until object appears at center of reticle. By means of angle of site knob, center bubble of angle of site level in its vial. The angle of site is then read on angle of site scale (100-mil steps) and micrometer (1-mil steps). An indication of 300 mils corresponds to a horizontal line of sight.

(5) The horizontal axis of the reticle is graduated at 5-mil intervals for 30 mils on each side of center. The two short lines above horizontal line are spaced 3 mils apart.

(6) To prepare instrument for traveling, remove sunshades and filters, if used, and place them in pockets of telescope carrying case. Cover objectives and eyepieces. With telescope shanks in a vertical position, press locking plunger and lift telescope from mount. Loosen telescope clamping knob and swing elevating mechanism against right or left hand telescope. Instrument will then fit snugly into the blocking of the case. Do not remove mount from tripod. Tripod leg clamping levers should not protrude.

c. Test and adjustment.—(1) Azimuth micrometer and azimuth scale should read zero simultaneously. The screw in the end of the micrometer may be temporarily loosened to permit slipping micrometer to desired position.

(2) Angle of site mechanism may be checked by observing a datum point of known angle of site. Small errors may be corrected by temporarily loosening screw in the end of knob and slipping micrometer and knob to correct position. If angle of site scale and micrometer then fail to indicate 3 and 0, respectively, simultaneously, instrument should be turned in for adjustment by authorized ordnance personnel.

(3) Ball-and-socket joint of the mount should have a snug friction fit when associated clamping lever is released. Excessive tightness or lost motion may be adjusted by means of the plug in the center of bottom of mount. This plug is locked by the retaining ring concentric therewith, which must be loosened for adjusting. Tighten retaining ring securely when adjustment is completed.

d. Care and preservation.—(1) See paragraph 58 for general instructions pertaining to care and preservation of instruments.

(2) Exposed moving parts should be oiled occasionally with a small quantity of neutral oil (temperature above 32° F.), or oil, lubricating, for aircraft instruments and machine guns (temperature below 32° F.). Interior parts are not to be lubricated by the using arm. Keep excess lubricant that seeps from the mechanisms wiped off to prevent accumulation of dust and grit.

58. Care and preservation of instruments.—*a. General.*—(1) The instructions given below supplement instructions pertaining to individual instruments included in this chapter.

(2) Fire-control and sighting instruments are in general rugged and suited for the purposes for which they have been designed. They will not, however, stand rough handling or abuse and inaccuracy or malfunctioning will result from such mistreatment.

(3) Disassembly and assembly by the using arm is permitted only to the extent authorized in the paragraphs pertaining to the individual instruments. Unnecessary turning of screws or other parts not incident to the use of the instrument is expressly forbidden.

(4) Keep the instruments as dry as possible. Never put an instrument in its carrying case when wet.

(5) When not in use, keep the instruments in the carrying cases provided, or in the condition indicated for traveling.

(6) Any instruments which indicate incorrectly or fail to function properly after the authorized tests and adjustments have been made

are to be turned in for repair by ordnance personnel. Adjustments other than those expressly authorized in the paragraphs pertaining to the individual instruments are not to be performed by the using arm.

(7) No painting of fire-control equipment by the using arm is permitted.

(8) Many worm drives have throw-out mechanisms to permit rapid motion through large angles. When using these mechanisms, it is essential that the throw-out lever be fully depressed to prevent injury to the worm and gear teeth.

(9) When using a tripod with adjustable legs, be certain that the legs are clamped tightly to prevent possibility of collapse.

(10) When setting up tripods on sloping terrain, place two legs on downhill side to provide maximum stability.

b. Leather articles.—Care and preservation of leather articles are covered in paragraph 38.

c. Optical parts.—(1) To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion and etching of the surface of the glass, which greatly interfere with the good optical qualities of the instrument, can be prevented or greatly retarded by keeping the glass clean and dry.

(2) Under no conditions will polishing liquids or pastes be used for polishing lenses and windows.

(3) For wiping optical parts use only paper specially intended for cleaning optical glass (U. S. A. Spec. 19-40). Use of cleaning cloths in the field is not permitted. To remove dust, brush glass lightly with a clean camel's-hair brush and rap brush against a hard body in order to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed. With some instruments an additional brush with coarse bristles is provided for cleaning mechanical parts. It is essential that each brush be used only for the purpose intended.

(4) Exercise particular care to keep optical parts free from oil and grease. Do not wipe lenses or windows with the fingers. To remove oil or grease from optical surfaces, apply ethyl alcohol (U. S. A. Spec. 4-1018) with a clean camel's-hair brush and rub gently with clean lens paper. If alcohol is not available, breathe heavily on the glass and wipe off with clean lens paper. Repeat this operation several times until clean.

(5) Moisture due to condensation may collect on optical parts of the instrument when the temperature of the parts is lower than that of the surrounding air. This moisture if not excessive can be removed by

placing the instrument in a warm place. Heat from strongly concentrated sources should never be applied directly as it may cause unequal expansion of parts resulting in breakage of optical parts or inaccuracies in observation.

d. Lubrication.—Lubricants authorized for use in the paragraphs pertaining to the individual instruments are covered by the following specifications:

Neutral oil	U. S. A. Spec. 2-81
Oil, lubricating, for aircraft instruments	
and machine guns	U. S. A. Spec. 2-27
Petrolatum	U. S. A. Spec. 2-67

CHAPTER 4

AMMUNITION

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59. General.—*a. Form issued.*—Ammunition for the 75-mm guns, M1897, M1897A2, and M1897A4, is issued in the form of "fixed" rounds, either unfuzed or as fuzed complete rounds. A complete round includes all of the ammunition components used in a cannon to fire one round.

b. Fixed ammunition.—In fixed ammunition the cartridge case, which contains the propelling charge and primer, is crimped rigidly to the projectile. Until recently, designs of fixed rounds provided for issue of the round unfuzed, the fuze to be assembled just prior to firing. In current designs the round is issued as a fixed complete round, the fuze being assembled to the round "as issued."

c. Nomenclature.—Standard nomenclature is used herein in all references to specific items of issue.

d. Firing tables.—Current firing tables are listed in the Appendix. An up-to-date list of firing tables is maintained in Standard Nomenclature List F-69.

60. Classification.—Dependent upon the kind of filler, projectiles may be classified according to type as explosive, chemical, or inert. Explosive projectiles comprise high explosive and practice, and shrapnel. High explosive projectiles contain a high explosive bursting charge, whereas shrapnel and practice projectiles contain a relatively small quantity of low explosive filler. The modern shrapnel is a projectile designed to carry a large number of spherical shot to a distance from the gun and there discharge them over an extended area. The low explosive filler for practice projectiles is intended solely as a spotting charge and for some purposes may be omitted. Chemical

projectiles comprise those containing a chemical filler, that is, a chemical agent which produces either a toxic or an irritating physiological effect, a screening smoke, an incendiary action, or a combination of these. Inert projectiles contain no explosive.

61. Identification.—Ammunition, including components, is completely identified by means of the painting, marking (includes ammunition lot number), and the accompanying data card. Other essential information such as weight zone and muzzle velocity may be obtained from the marking and data card. (See figs. 62, 63, 64, and 65 and *a*, *b*, and *c* below.)

a. Mark or model.—To identify a particular design a model designation is assigned. This model designation becomes an essential part of the standard nomenclature and is included in the marking on the item. Prior to July 1, 1925, it was the practice to assign mark numbers, the word "Mark" being abbreviated "Mk.," which was followed by a roman numeral, for example, SHELL, HE, Mk. I. The first modification of a model was indicated by the addition of MI, the second by MII, etc. Thus, Mk. IMII would indicate the second modification. The present system of model designation consists of the letter M followed by an arabic numeral. Modifications are indicated by adding the letter A and appropriate arabic numeral. Thus, M9A1 indicates the first modification of an item for which the original model designation was M9.

b. Lot number.—(1) When ammunition is manufactured an ammunition lot number, which becomes an essential part of the marking, is assigned in accordance with pertinent specifications. This lot number is stamped or marked on every loaded complete round, on all packing containers, and on the accompanying ammunition data card. It is required for all purposes of record, including reports on condition, functioning, and accidents in which ammunition is involved. To provide for the most uniform functioning, all of the rounds in any one lot of fixed ammunition consist of—

- (a) Projectiles of one lot number (one type and one weight zone).
- (b) Fuzes of one lot number.
- (c) Primers of one lot number.
- (d) Propellant powder of one lot number.

(2) Therefore to obtain the greatest accuracy in any firing, successive rounds should be from the same ammunition lot, whenever practicable.

c. Data card.—A 5- by 8-inch card, known as an ammunition data card, is packed in each packing box with the ammunition, or in the case of bundle packing, with the round in each fiber container. When

required assembling instructions are printed on the reverse side of the card.

62. Painting and marking.—*a. Painting.*—All projectiles are painted to prevent rust and by means of the color to provide a ready means for identification as to type. The color scheme is as follows:

- (1) High explosive projectiles, yellow; marking in black.
- (2) Chemical projectiles, gray. One green band painted on a chemical projectile indicates nonpersistent gas. Two green bands indicate persistent gas. One yellow band indicates a smoke projectile. The marking on chemical projectiles is in the same color as the band.
- (3) Shrapnel, red; marking in black.
- (4) Practice projectiles, blue; marking in white. These may contain only a sand filler with an inert fuze or they may contain a live fuze with a spotting charge of black powder.
- (5) Dummy or drill projectiles which do not contain any explosive, black; marking in white.

b. Marking.—(1) *On projectile.*—The following information is stenciled or stamped on the projectile in all fixed rounds except shrapnel. On shrapnel, the only marking required on the projectile is that of caliber, type of cannon in which fired, and lot number.

- (a) Caliber and type of cannon in which fired.
- (b) Kind of filler, for example, TNT, CN GAS, etc.
- (c) Mark or model of projectile.
- (d) Weight zone marking.
- (e) Lot number of loaded projectile. Because the lot number of the loaded projectile is ordinarily not required after the complete round has been assembled, it is stenciled below the rotating band, in which position it is covered by the neck of the cartridge case.

(2) *On cartridge case.*—Changes have been made recently in the marking on cartridge cases. The new marking which is being used on ammunition of new manufacture as well as on currently renovated ammunition is shown compared with the old marking in (a) and (b) below.

- (a) On the body of the cartridge case, marking in black unless otherwise indicated.

Old marking	New marking
FLASHLESS when propelling charge is of flashless (FNH) powder.	Omitted.

Old marking	New marking
REDUCED CHARGE between two black bands indicates reduced charge; "SUPERCHARGE" in red or black indicates supercharge; absence of such markings indicates normal charge.	REDUCED CHARGE between two black bands indicates reduced charge; NORMAL below one black band indicates normal charge; "SUPER" indicates supercharge.
Initials of powder manufacturer, symbol of powder, and lot number.	Omitted.
Caliber and type of cannon in which fired.	Omitted.
Muzzle velocity in feet per second. On normal charge rounds muzzle velocity is inclosed in a black rectangle.	Omitted.

(b) On the base of cartridge case, marking in black unless otherwise indicated.

Ammunition lot number (in older lots, stamped in the metal).	Ammunition lot number and initials of loader.
FLASHLESS when propelling charge is flashless (FNH) powder.	Omitted.
Model of projectile. Absence of such model indicates shrapnel. If chemical, the kind of filler is shown.	Model of projectile.
One diametral stripe indicates normal charge; two diametral stripes at right angles indicate reduced charge; SUPERCHARGE indicates supercharge.	NORMAL below one diametral stripe indicates normal charge; REDUCED and two diametral stripes at right angles indicate reduced charge; "SUPER" indicates supercharge.
Caliber, type, and model of cannon in which fired (stamped in the metal).	Caliber and model of cartridge case (stamped in the metal).
Cartridge case lot number and initials of cartridge case manufacturer (stamped in the metal).	Cartridge case lot number, initials of cartridge case manufacturer, and year of manufacture (stamped in the metal).

63. Weight zone markings.—Because it is not practicable to manufacture projectiles, shrapnel excepted, within the narrow weight limits required for the desired accuracy of fire, projectiles are grouped into weight zones in order that appropriate ballistic corrections indicated by firing tables may be applied. The weight zone of each projectile is marked thereon by means of crosses, one, two, three, or more, dependent upon weight of the projectile. A weight zone lighter than one cross is indicated by L. LL indicates a weight zone lighter than L. Two crosses indicate normal weight.

64. Care and preservation.—*a.* Complete rounds and ammunition components are packed to withstand conditions ordinarily encountered in the field. Each complete round is packed in an individual moisture-resistant metal or fiber container and then in a wooden packing box or bundle. Fuze which are issued separately are packed in sealed metal-lined boxes. Nevertheless, since explosives are adversely affected by moisture and high temperature, due consideration should be given to the following:

(1) Do not break moisture-resistant seal until ammunition is to be used.

(2) Protect ammunition, particularly fuzes, from high temperatures, including the direct rays of the sun. More uniform firing is obtained if rounds are at the same temperature.

b. Do not attempt to disassemble any fuze.

c. Do not remove adapter closing plug from unfuzed rounds until fuze is to be assembled thereto. The adapter closing plug is provided to keep the fuze opening free of foreign matter in order that the fuze may be readily and properly screwed in.

d. Handle fuzes with care. The explosive elements are particularly sensitive to undue shock and high temperature.

e. The complete round should be free of foreign matter, sand, mud, grease, etc., before loading into the gun.

f. Do not remove protection or safety devices from fuzes until just before use.

g. Components of rounds prepared for firing but not fired will be returned to their original packings and appropriately marked. Such components will be used first in subsequent firings in order that stocks of opened packings may be kept at a minimum.

65. Authorized rounds.—The 75-mm guns, M1897, M1897A2, and M1897A4, being chambered alike, fire the same ammunition. The ammunition authorized for use therein is listed below. It will be noted that the designation completely identifies the ammunition as to type

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and model of projectile and fuze, type and kind of propelling charge, and caliber of gun in which the round is fired. To the nomenclature of ammunition which is issued unfuzed, a suffixed statement such as "adapter for fuze, P. D., Mk. III, Mk. IV, M35, M46, or M47" indicates the fuzes authorized for use therewith. For ammunition which is issued fuzed, a statement in the nomenclature such as "with fuze, P. D., M48" indicates the type and model of fuze assembled thereto.

Ammunition for 75-mm field guns, M1897, M1897A2, and M1897A4

Nomenclature	Prescribed fuzes		Substitute fuzes	
	Model	Action	Model	Action
<i>Service ammunition</i>				
Shell, fixed, gas, persistent, HS, Mk. II, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46----- M47.	SQ----- Del.	Mk. III or M35 Mk. IV Star.	SQ. Del.
Shell, fixed, gas, persistent, HS, T10, with fuze, P. D., T18.	T18-----	SQ-----		
Shell, fixed, gas, persistent, NC, Mk. II, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46----- M47.	SQ----- Del.	Mk. III or M35 Mk. IV Star.	SQ. Del.
Shell, fixed, HE, M48, normal charge, with fuze, P. D., M48.	M48-----	SQ-Del-----		
Shell, fixed, HE, M48, normal charge, with fuze, P. D., M54.	M54-----	Time-SQ-----		
Shell, fixed, HE, M48, reduced charge, with fuze, P. D., M48.	M48-----	SQ-Del-----		
Shell, fixed, HE, M48, reduced charge, with fuze, P. D., M54.	M54-----	Time-SQ-----		
Shell, fixed, HE, M48, super-charge, with fuze, P. D., M48.	M48-----	SQ-Del-----		
Shell, fixed, HE, M48, super-charge, with fuze, P. D., M54.	M54-----	Time-SQ-----		

See notes at end of table.

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Ammunition for 75-mm field guns, M1897, M1897A2, and M1897A4—Continued

Nomenclature	Prescribed fuzes		Substitute fuzes	
	Model	Action	Model	Action
<i>Service ammunition—Continued</i>				
Shell, fixed, HE, Mk. I, flashless, reduced charge, unfuzed (adapted for fuze, P. D., M46, Mk. IV, or M47).	M46 M47.	SQ. Del.	Mk. IV.	Del.
Shell, fixed, HE, Mk. I, flashless, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46 M47.	SQ. Del.	Mk. III or M35 Mk. IV Star.	SQ. Del.
Shell, fixed, HE, Mk. I, reduced charge, unfuzed (adapted for fuze, P. D., Mk. IV, M46, or M47).	M46 M47.	SQ. Del.	Mk. IV.	Del.
Shell, fixed, HE, Mk. I, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46 M47.	SQ. Del.	Mk. III or M35 Mk. IV Star.	SQ. Del.
Shell, fixed, smoke, FM, Mk. II, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46 M47.	SQ. Del.	Mk. III or M35 Mk. IV Star.	SQ. Del. ¹
Shell, fixed, smoke, FS, T10, with fuze, P. D., T18.	T18.	SQ.		
Shell, fixed, smoke, phosphorus, WP, T10, with fuze, P. D., T18.	T18.	SQ.		
Shell, fixed, smoke, phosphorus, WP, Mk. II, unfuzed (adapted for fuze, P. D., Mk. III, Mk. IV Star, M35, M46, or M47).	M46.	SQ.	Mk. III or M35.	SQ.
Shrapnel, fixed, Mk. I.	M1907M.	21-second.		
Shrapnel, fixed, Mk. I, flashless.	M1907M.	21-second.		
<i>Target practice ammunition</i>				
Shell, fixed, practice, sand-loaded, Mk. I (with inert fuze, P. D., Mk. IV).	Mk. IV, inert.			

See notes at end of table.

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Ammunition for 75-mm field guns, M1897, M1897A2, and M1897A4—Continued

Nomenclature	Prescribed fuzes		Substitute fuzes	
	Model	Action	Model	Action
<i>Blank ammunition</i>				
Ammunition, blank (1-pound charge), 75-mm guns, M-1897, M1916, M1917, and 75-mm pack howitzer M1 and M1A1.	None-----		None-----	
Ammunition, blank (double-pellet charge), 75-mm guns M1897, M1916, M1917, and 75-mm pack howitzer, M1 and M1A1.	None-----		None-----	
<i>Drill ammunition</i>				
Cartridge, drill, M7, 75-mm guns, M1897, M1916, M-1917.	M1907M, inert. M46, inert. ² M47, inert. ²		Mk. III, inert. ² Mk. IV, inert. ²	
<i>Subcaliber ammunition</i>				
Shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun, M1916.	M38 -----			
Shell, fixed, LE., Mk. I, with fuze, B. D., Mk. I, 37-mm gun, M1916.	Mk. I -----			
Shell, fixed, sand-loaded, Mk. I, 100 percent service charge, 37-mm gun, M1916.				

¹ Fired for ricochet only.² Requires adapter, 72-3-66M.

SQ, Superquick.

Del, Delay.

PD, Point detonating.

66. Fuze.—*a. General.*—A fuze is a mechanical device used with a projectile to explode it at the time and under the circumstance desired.

NOTE.—No attempt will be made to disassemble any fuze. The only authorized operation will be that of screwing the fuze into the projectile, or out if not fired (par. 64g).

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b. Types.—(1) Fuze may be classified into two principal types, namely, those which function by time action a certain number of seconds after firing, and those which function as the result of impact of the fuze or the projectile with a resistant object.

(2) Further subdivision of the impact types is dependent upon quickness of action, classifications being superquick, nondelay, short delay, and long delay.

(3) Dependent upon manner of arming, certain fuze are considered to be boresafe as distinct from those which are not boresafe. A boresafe fuze is one in which the explosive train is so interrupted that prior to firing and while the projectile is in the bore of the cannon, premature functioning of the projectile cannot occur even though the more sensitive explosive elements in the fuze should function prematurely.

c. Boresafe and nonboresafe.—Fuze classified as boresafe and nonboresafe are—

Nonboresafe	Boresafe
Point detonating:	Point detonating:
Mk. III, superquick:	
Without interrupter-----	M48. ¹
With interrupter-----	M54. ¹
Mk. IIIA, superquick:	
Without interrupter-----	T18. ¹
With interrupter-----	
Mk. IV, short delay-----	
Mk. IV Star, short delay-----	
M35-----	
M46-----	
M47-----	
Combination, 21-second, M1907M ¹ -----	

¹ Assembled to fixed round. Not issued separately for use in the field.

67. Point detonating fuze.—*a. Mk. III, superquick.*—(1) *Without interrupter.*—Except that this fuze has no interrupter, it is the same as the Mk. III, superquick, with interrupter. With this exception the description in (2) below applies.

(2) *With interrupter.*—(a) *Description.*—This fuze, shown in figure 66, is of the direct action type intended to detonate with the least possible penetration of the projectile. Subject to the provisions of AR 750-10, authorized use is shown in paragraph 65. It should not be used in ammunition with a reduced charge since its use at this lower velocity causes the projectile to be unstable in flight.

(b) *Preparation for firing.*—To assemble the fuze to the round proceed as follows:

1. Remove adapter closing plug from the projectile.
2. Visually inspect fuze cavity and threads. They should be free of any foreign matter which would interfere with the proper assembly of the fuze.
3. Screw fuze into the adapter by hand. (It is essential that the felt washer provided with the fuze be under detonator socket flange when fuze is screwed into adapter.) Tighten with fuze wrench. Use only fuzes on which the original waterproof seal of lead foil cap is unbroken.
4. Before loading the round into the gun remove waterproof cap by pulling on the exposed loose end of tape. Examine spiral (brass ribbon) where it is coiled around the fuze and safety pin visually to see that they are in good condition. When either is damaged or missing, the fuze will be removed and replaced by a serviceable fuze. Complete round is then ready for firing. The unserviceable fuze will be disposed of.

(b) *Mk. IIIA, superquick.*—(1) *Without interrupter.*—This fuze may be distinguished from the Mk. III, superquick, without interrupter, by the A in the model designation stamped on the body of the fuze. Otherwise, the only difference between these two fuzes is arrangement of upper detonator.

(2) *With interrupter.*—This fuze may be distinguished from the Mk. III, superquick, with interrupter, by the A in the model designation, stamped on the body of the fuze. Otherwise, the only difference between these two fuzes is in arrangement of upper detonator.

(c) *Mk. IV, short delay.*—This fuze will be replaced by the point detonating fuze, M47 (g below). Pending replacement, the Mk. IV, short delay, will be used as provided for in existing instructions.

(d) *Mk. IV Star, short delay.*—This fuze will be replaced by the point detonating fuze, M47 (g below). Pending replacement, the Mk. IV Star, short delay, will be used as provided for in existing instructions.

(e) *M35.—Description.*—This fuze, shown in figure 67, is a modified Mk. III, superquick type. Compared with the Mk. III type, it is somewhat shorter, and a sleeve has been added to hold the spiral (brass ribbon) in position. The sleeve is held in place by a pin which is sheared by setback in firing, thereby freeing the spiral. For safety in transportation a spring clip, designated "sleeve support," is used. This fuze like the Mk. III type is unsuitable for use in reduced charge rounds due to lack of stability of the projectile.

(2) *Preparation for firing.*—To assemble the fuze to the round, proceed as follows:

- (a) Remove adapter closing plug from projectile.
- (b) Visually inspect fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.
- (c) Screw fuze into adapter by hand. (It is essential that the felt washer provided with the fuze be under detonator socket flange when fuze is screwed into adapter.) Tighten with fuze wrench.
- (d) By means of a pull on the ring, remove sleeve support. The round is then ready for firing.

f. M46.—(1) *Description.*—This fuze, a superquick type, shown in figure 68, is a further modification of the Mk. III type. The firing mechanism has been modified to eliminate the spiral and split rings. A lighter firing pin is supported on a brass cup which is sufficiently strong to resist the setback produced by acceleration in the gun, but which is crushed when the firing pin is driven into the primer on impact. This fuze is suitable for use with either normal or reduced charge rounds.

(2) *Preparation for firing.*—To fuze the round proceed as follows:

- (a) Remove adapter closing plug from projectile.
- (b) Visually inspect fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.
- (c) Screw fuze into adapter by hand. (It is essential that the felt washer provided with the fuze be under detonator socket flange when fuze is screwed into adapter.) Tighten with fuze wrench. The complete round is then ready for firing.

g. M47.—(1) *Description.*—This fuze, a delay type, shown in figure 69, is identical ballistically with the point detonating fuze, M46. It can be distinguished from the latter fuze, however, by the marking and the black head, the M46 fuze has a white head. To provide for delay action, a delay pellet, about 0.05 second, is incorporated in the explosive train between upper detonator and lower detonator.

(2) *Preparation for firing.*—To fuze the round proceed as follows:

- (a) Remove adapter closing plug from projectile.
- (b) Visually inspect fuze cavity and threads. They should be free of foreign matter which would interfere with proper assembly of the fuze.
- (c) Screw fuze into adapter by hand. (It is essential that the felt washer provided with the fuze be under detonator socket flange when

fuze is screwed into adapter.) Tighten with fuze wrench. The round is then ready for firing.

h. M48.—(1) *Description.*—This fuze, shown in figure 70, is a combination superquick and short delay type. It will always be issued assembled to shell. The fuze contains two actions, superquick and delay. On the side of the fuze near the base is a slotted "setting sleeve" and two registration lines, one parallel to axis of fuze, the other at right angles thereto. The line parallel to the axis is marked S. Q., the other DELAY. To set the fuze, the setting sleeve is turned so that the slot is alined with S. Q. or DELAY, whichever is required. The setting may be made or changed at will with a screw driver or other similar instrument any time before firing, even in the dark by noting the position of the slot, parallel to the fuze axis for S. Q., at right angles thereto for DELAY. It should be noted that in this fuze even though set superquick, the delay action will operate if the superquick action fails to function.

(2) *Preparation for firing.*—Prior to firing it is only necessary to set the fuze and this only when delay action is required. When shipped the fuze is set superquick.

i. M54.—(1) *Description.*—This standard fuze, shown in figure 71, is a combination time and superquick type. These fuzes will always be issued assembled to shell. A safety pin extends through the fuze to secure the time plunger during shipment. The fuze contains two actions, time and superquick. The superquick action is always operative and will function on impact, unless prior functioning has been caused by the time action. Therefore, to set the fuze for superquick action, it is required that the time action be set either at safe (S) or for a time longer than the expected time of flight. The time train ring, graduated for 25 seconds, is similar to that of other powder time train fuzes. To prevent extremely short time action, an internal safety feature is incorporated in the time train. This safety feature prevents the time action from functioning should the fuze be set for less than 0.4 seconds. Therefore when setting for time action, the setting should always be greater than this minimum of 0.4 seconds. The fuze is set for time by means of a fuze setter.

(2) *Preparation for firing.*—Prior to firing, the safety pin must be withdrawn from the fuze. If superquick action is required, the graduated time ring is set safe (S) or for a time greater than the expected time of flight.

NOTE.—The fuze, as shipped, is set safe. If time action is required, the graduated time train ring is set for the required time of burning by means of a fuze setter.

j. T18.—(1) *Description.*—This fuze, shown in figure 72, is a superquick time type. These fuzes will always be issued assembled to shell. The fuze provides only for superquick action.

(2) *Preparation for firing.*—No special preparation prior to firing is required.

68. Combination fuze, 21-second, M1907M.—*a. Description.*—This fuze, shown in figure 73, is a combination percussion time type, designed for use with shrapnel. These fuzes will always be issued assembled to shell. The fuze contains two actions, percussion and time. The percussion action is always operative and will function on impact unless prior functioning has been caused by the time action. When percussion action is required, it is only necessary to set the graduated time train ring at safe (S) or for a time longer than the expected time of flight. The time train ring is similar to that of other powder time train fuzes and is graduated for 21.2 seconds. The fuze is set for time by means of a fuze setter. In the particular case of zero (0) setting, canister effect is obtained, that is, the fuze functions just beyond the muzzle of the cannon with the result that the shrapnel balls are projected from the shrapnel case somewhat similar to shot from a shotgun. Because the powder time train is adversely affected by moisture, every effort will be made to keep the fuze dry.

b. Preparation for firing.—The waterproof fuze cover must first be removed. If percussion action is required, the graduated time is set safe (S) or for a time greater than the expected time of flight.

NOTE.—The fuze as shipped is set safe. If time action is required, the graduated time train ring is set for the required time of burning by means of a fuze setter.

69. Packing.—*a.* Fixed rounds of 75-mm gun ammunition are packed in individual metal or fiber containers, and these in wooden boxes containing four rounds or in special bundle packings of three rounds. While the weights of the individual rounds vary somewhat, depending upon type and model, the following data are considered representative for estimating weight and volume requirements:

	Weight (pounds)	Volume (cubic feet)
Complete round without packing material	18	
3 rounds in bundle packing	69	1.0
4 rounds in wooden packing box	100	1.7

The overall dimensions of the packings are:

3-round bundle (inches), $27\frac{1}{8}$ by 8.10 by 7.57.

4-round box (inches), $30\frac{3}{4}$ by $9\frac{1}{16}$ by $9\frac{1}{16}$.

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Bundles for oversea shipment are crated.

b. Fuze.—Similar representative data for fuzes are:

Approximate dimensions of wooden box (inches), 18 by 9 by 8.

Approximate volume (cubic feet), 0.80.

Approximate weight of box and 50 fuzes¹ (pounds), 53.

70. Subcaliber.—*a. General.*—The shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun, M1916 is authorized for use in the 37-mm gun, M1916, when used for subcaliber purposes with the 75-mm gun, M1897, M1897A2, and M1897A4. This ammunition is issued in the form of fixed complete rounds. The projectile is fitted with a base fuze and contains a low explosive filler of black powder. When used for target practice purposes the low explosive filler serves as a spotting charge. The complete round is shown in figure 74, and may be identified by the marking indicated thereon.

b. Packing.—Two standard packings of 60 rounds each are provided, one, a wooden box with metal liner for oversea shipments, the other a wooden box without metal liner for domestic shipments. Data for these packings are as follows:

	Weight (pounds)	Volume (cubic feet)
Complete round without packing material	1.62	
Oversea shipments:		
Box with metal liner (60 rounds)	128	1.99
Overall dimensions of box (inches);		
$23\frac{5}{16}$ by $13\frac{5}{16}$ by $11\frac{1}{16}$.		
Domestic shipments:		
Box without metal liner (60 rounds)	115	1.60
Overall dimensions of box (inches),		
$21\frac{1}{2}$ by $12\frac{1}{16}$ by $10\frac{5}{32}$.		

¹ Point detonating fuze, Mk. IV, short delay, being smaller, is packed 100 per box of approximately the same size and weight.

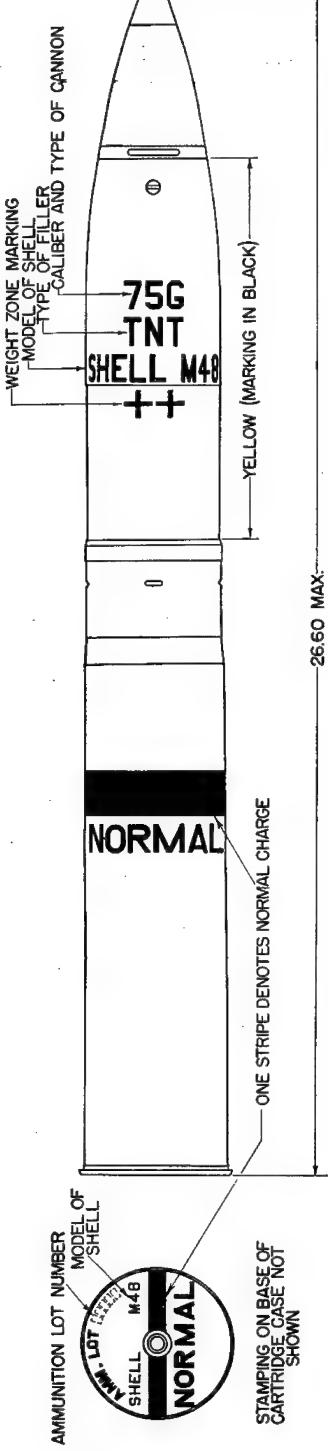


FIGURE 62.—Shell, fixed, HE, M48, with point detonating fuze, M48, 75-mm gun, as fired.

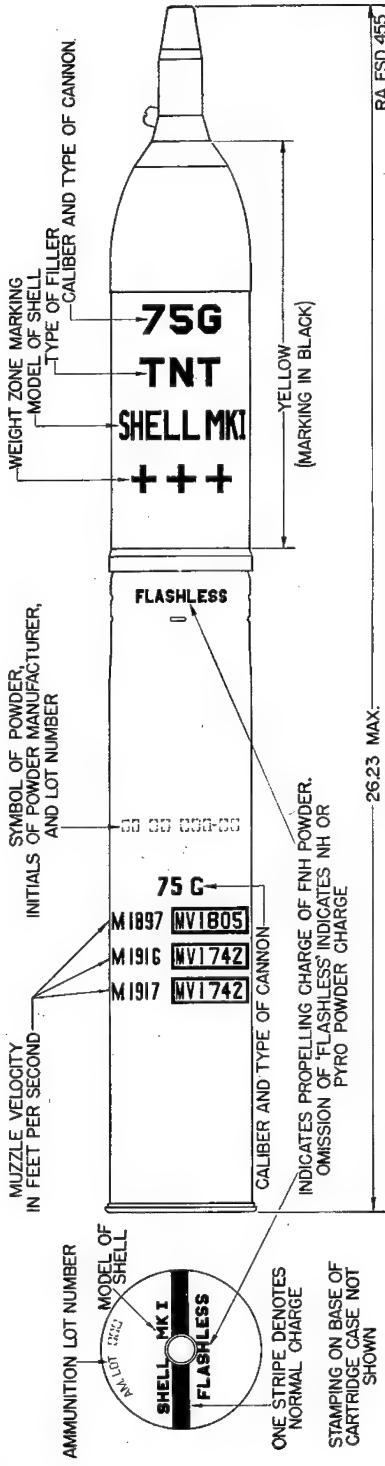


FIGURE 63.—Shell, fixed, HE, Mk. I, 75-mm gun, with point detonating fuze, M46, as fired.

LOADER'S LOT NUMBER, LOADER'S INITIALS
AND DATE (MONTH AND YEAR) LOADED.

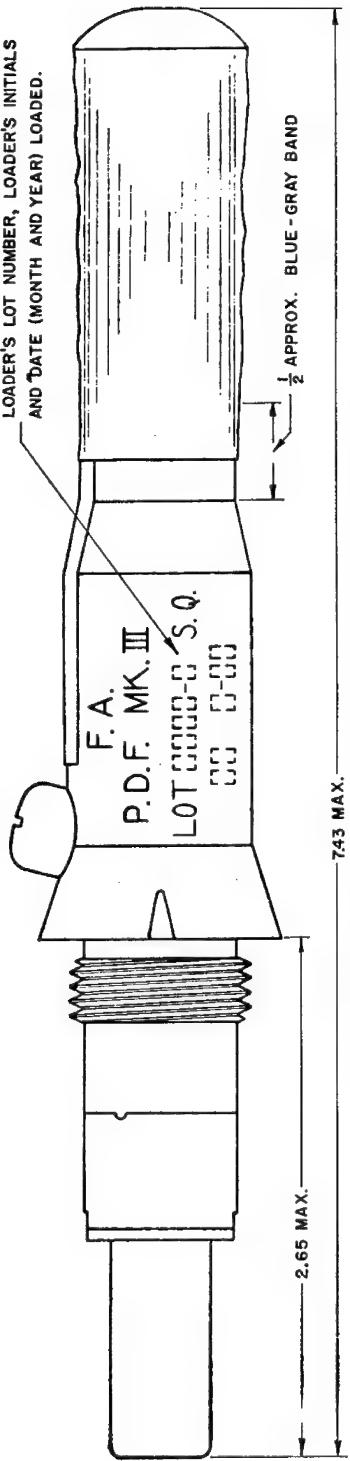


FIGURE 66.—Fuze, point detonating, Mk. III, superquick, with interrupter.

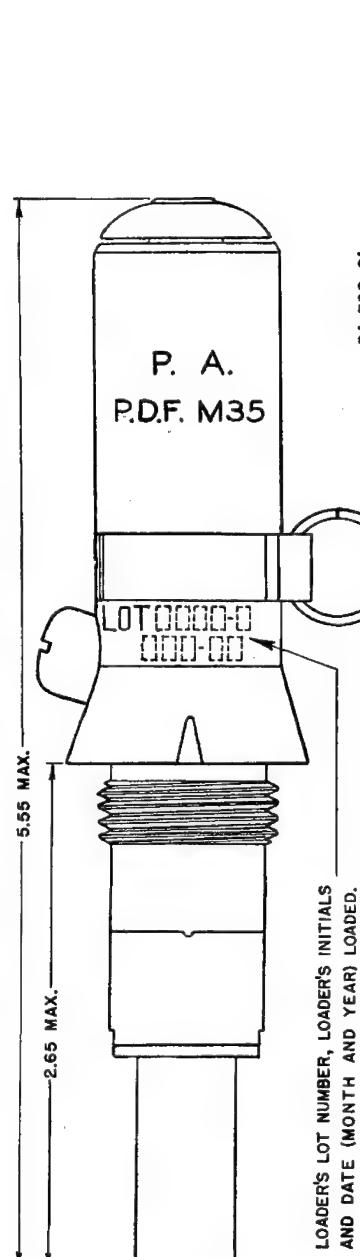


FIGURE 67.—Fuze, point detonating, M35.

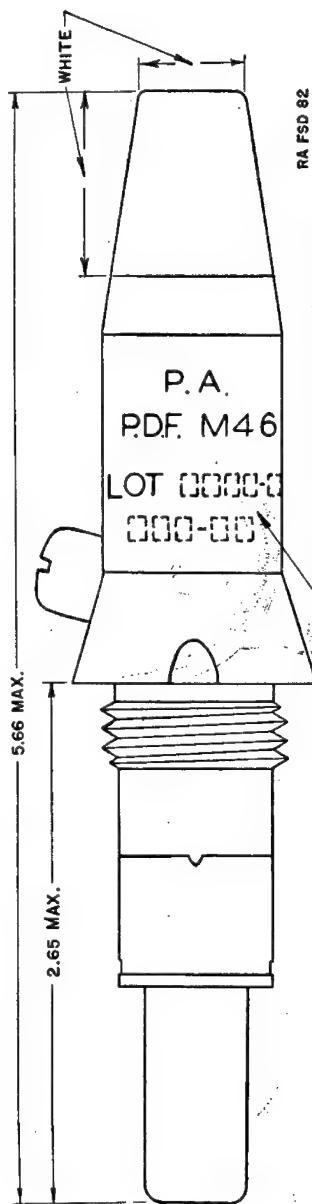


FIGURE 68.—Fuze, point detonating, M46.

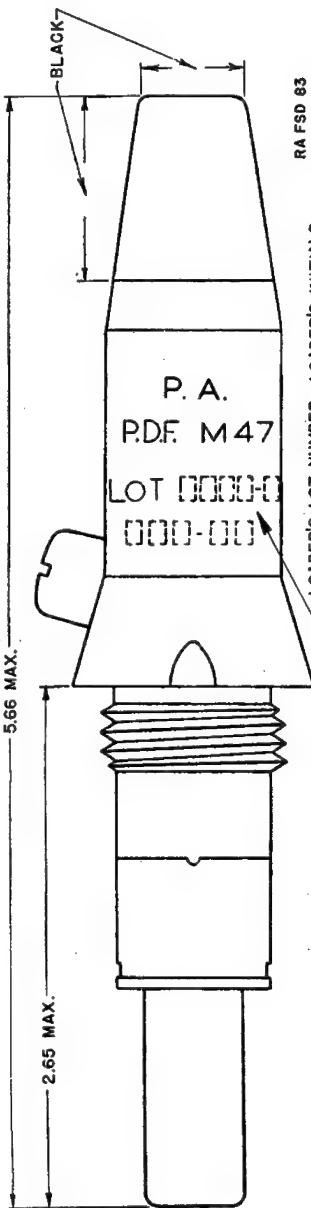


FIGURE 69.—Fuze, point detonating, M47.

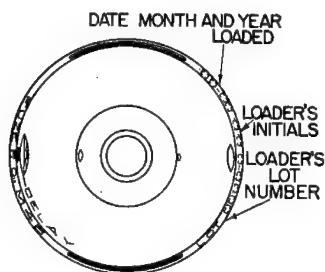
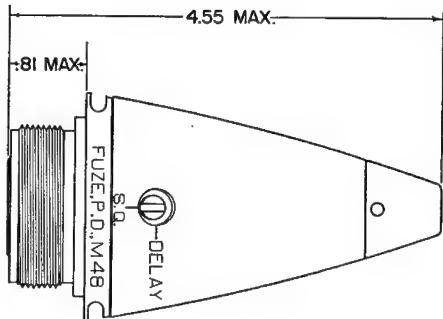


FIGURE 70.—Fuze, point detonating, M48.

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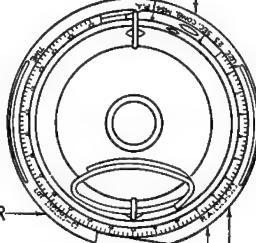
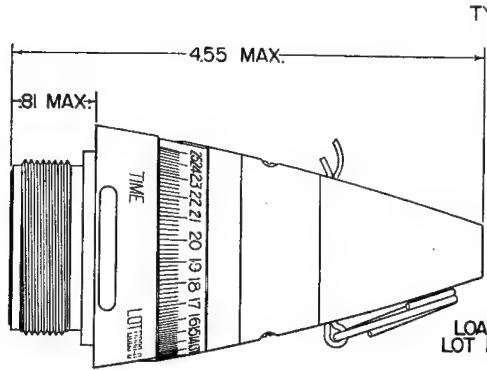


FIGURE 71.—Fuze, point detonating, M54.

RA FSD 459

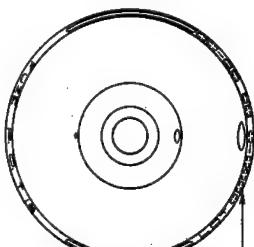
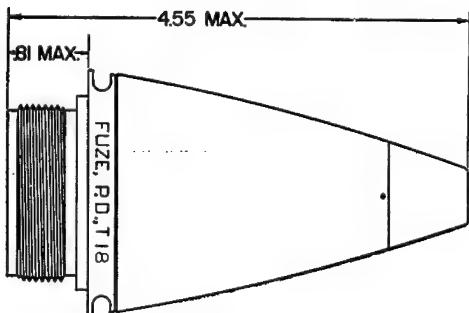


FIGURE 72.—Fuze, point detonating, T18.

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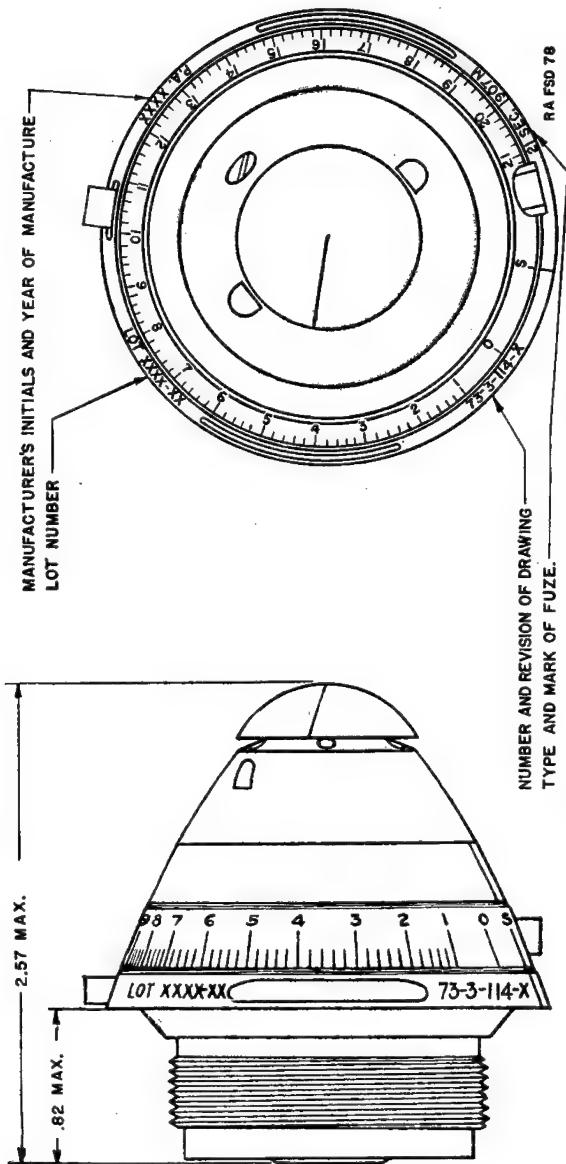


FIGURE 73.—Fuze, combination, 21-second, M1907M.

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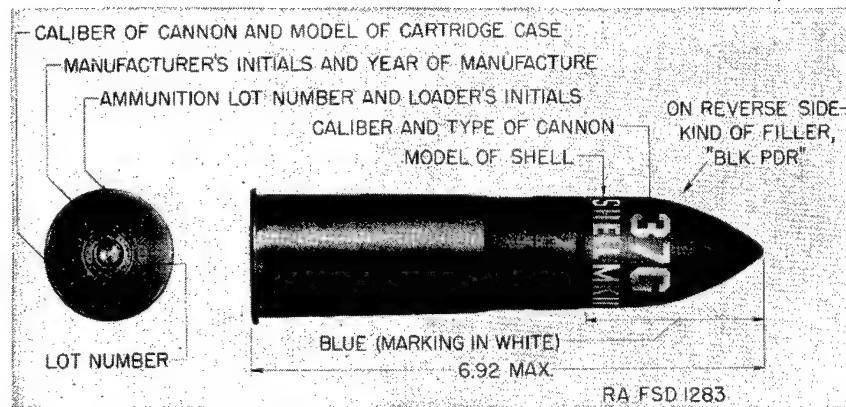


FIGURE 74.—Shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun, M1916.

CHAPTER 5

LIMBERS AND CAISSONS

(For horse-drawn artillery)

	Paragraph
General	71
Description and use	72
Inspection	73
Disassembly and assembly	74
Care, maintenance, and adjustment	75
Lubrication	76

71. General.—The limber is a two-wheeled vehicle to which the trail of the carriage is fastened to form a four-wheeled complete carriage for the gun when traveling. The caisson is built primarily to carry ammunition. Fixtures are provided on the outside for holding such miscellaneous equipment as picks, shovels, and similar tools. A name plate, giving name, number, and model of the vehicle, name of manufacturer, year of completion, and initials of the inspector, is attached to each vehicle. All reports and correspondence concerning a particular vehicle must always refer to it by name, model, and serial number given on the name plate. Location of name plates on the various vehicles will be found in the description of the particular vehicles. In all requisitions and correspondence the correct name and the piece mark referred to should be given. This may be obtained from standard nomenclature lists. If name of part is unknown, submit a sketch showing location, shape, material, etc., sufficient to establish definitely the identity of the part in question.

72. Description and use.—*a. Limber.*—The 75-mm gun carriage limber, M1918, and the 75-mm gun caisson limber, M1918 (figs. 77 and 78), respectively, are substantially the same, except for the ammunition chest. The limber chest carries 18 rounds of ammunition and 3 oil cans, whereas the caisson limber chest is larger, carrying 36 rounds of ammunition and 3 oil cans. The top of the chest forms a seat for the gunners. The automatic pole support is shown in figure 80.

b. Caisson.—The gun caisson (fig. 79) is provided with an ammunition chest designed to carry 70 rounds of ammunition. The top of the chest forms a seat for the gunners.

c. Hand reel.—The hand reel, M1917, attached to the caisson, is a hand-operated reel for transportation and handling of telephone wire.

The reel is so mounted on top of the caisson chest that it can be removed readily and replaced by another spool. A removable crank is mounted on left end of the shaft. When removed it is held by a clip riveted to end of frame. A hinged crank, mounted on end of driving gear, is so designed that it may be folded compactly against the frame. When folded back, the crank is disengaged from the driving gear for controlling speed of the spool. The spool may be operated from either side. In laying out wire, the left crank is removed and placed in the clips on the left end of the frame, the pin is removed from the end of driving gear, and right crank is folded back and placed on crank rest, the drum then being free to revolve. Speed of the drum in paying out the wire is controlled by the action of the brake. In recovering wire place right and left cranks in position. Revolving left crank operates the driving gear, the right crank being connected directly to the shaft on which the spool is mounted. The reel is also fitted with a brake for controlling speed of rotation when allowing wire to run out. The brake lever is operated by a thong attached to lower end of the lever. A thong or cord long enough to reach to the seat of the limber, if desired, may be reeved through lower end of brake lever to operate the brake mechanism. By pulling the thong the upper end of the lever is made to drag on inside of rim of left spool flange. A brake release spring attached to upper end of lever, and a lug on the left shaft bearing keeps brake open when not in use.

d. Common parts.—Wheels, dust guards, singletrees, doubletrees, drawbars, poles, neckyokes, etc., are interchangeable when used with the proper vehicle.

(1) *Lunette.*—The ring in the trail of a gun carriage or rails of a caisson by which it is attached to the limber is called the lunette. The hook of the limber with which the lunette engages is called the pintle. The pintle is free to rotate. The lunette used for horse-drawn batteries has a small eye. For motorized batteries trucks replace the limbers and a different type of lunette is used. This lunette has a larger eye and no provision is made for an automatic pole support. Therefore care should be taken that the proper type is used.

(2) *Padlocks.*—Limber and caisson ammunition chests are furnished with a padlock marked "Ammunition" which is supplied with one key only. All ammunition keys are interchangeable. The padlocks furnished for each separate vehicle other than those having ammunition chests are alike and are supplied with two keys each. Each padlock and the keys belonging to it are stamped with a serial number.

73. Inspection.—*a.* Battery commanders should make frequent detailed inspections of all vehicles.

b. Vehicles cannot be kept in serviceable condition unless proper attention is given to cleaning, lubrication, and to loose or broken parts. Special attention should be given to sliding and bearing surfaces. These, together with screw threads and exterior parts, must be kept as free from dirt and other foreign matter as possible. Extra precautions should be observed regarding the foregoing, particularly when proceeding with disassembling and assembling operations.

c. When the limber and caisson props are in the traveling position the automatic pole support (fig. 80) retains the pole assembly at a constant height of 29.25 inches. When inspection shows that the pole is not supported at the proper height the cause should be determined and the necessary correction made. Usually this may be attributed to either a loose or bent pole in the pole socket or the automatic pole support spring not being properly adjusted. For detailed instructions relative to adjusting the automatic pole support see paragraph 75.

d. Dust guards should be examined to see that they are in serviceable condition. If the wool is matted with grease and dirt it should be washed with dry-cleaning solvent.

e. Nuts on the hub bolts should be tightened monthly during the first year of service and twice a year thereafter. Ends of the bolts should be slightly peened over to prevent the nuts from unscrewing.

f. Soaking wheels in water to tighten spokes and felloes is forbidden.

74. Disassembly and assembly.—*a. 75-mm gun carriage limber, M1918, and 75-mm gun caisson limber, M1918.*—Principal parts of the limber are wheels, axle, frame, ammunition chest, pole, double-tree, singletree, and neckyoke. Such parts as are assembled in place with standard hardware may be readily disassembled and assembled without detailed instructions.

(1) *To dismount the automatic pole support (fig. 80).*—*(a)* Remove guide bolt.

(b) Remove two bolts which pass through pintle bearing guide. For replacement purposes and in new equipment standard cap screws, $\frac{3}{4}$ -10NC-2 by $5\frac{1}{4}$ and 1-8NC-2 by $6\frac{1}{4}$ with regular hexagon nuts and lock washers will be used in place of these two bolts.

(c) Remove the two pintle bearing trunnion bolts.

(d) Pull mechanism out to the rear.

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(e) Remove pole supporting spring rod nut and pole supporting spring.

(f) Remove pintle nut and pintle bearing spring and withdraw pintle.

(2) *To mount automatic pole support.*—Proceed in reverse order to that outlined in (1) above.

b. *75-mm gun caisson, M1918.*—Principal parts of the caisson are wheels, axle, frame, carrying springs, brakes, ammunition chest, and apron. Such parts as are assembled in place with standard hardware may be readily disassembled and assembled without detailed instructions.

(1) *To dismount brake band.*—(a) Remove wheel.

(b) Remove cotter pins of brake band end pins and rear brake rod end pin.

(c) Drift out brake rod end pin and lower brake band end pin.

(d) Swing outer crank to rear, raising upper brake band end pin.

(e) Drift out upper brake band end pin.

(f) In the first brakes of this model adjusting nuts were attached to the brake band end by a straight pin held by a cotter pin in the adjusting link which engaged a notch in the pin. The straight pin is replaced by a bolt with a thin head and nut. The head is assembled on the outside and just clears the spokes.

(2) *To assemble brake band or newly relined brake band.*—(a) Proceed in reverse order to that outlined in (1) above.

(b) In assembling a newly relined brake band, loosen adjusting link and note that adjusting nut is assembled to proper end of band so that when adjusting link is assembled to lower arm of brake shaft, the brake band guides enter the clips.

(c) Smooth all burs and roughness on brake drum (fig. 79) but do not put oil or grease on it or the lining.

75. **Care, maintenance, and adjustment.**—a. *General.*—Care and maintenance of these vehicles and attachments consist mainly in cleaning and oiling where necessary, and tightening or properly adjusting bolts, nuts, and such parts as may be assembled by hand or with use of common hand tools.

b. *Brake mechanism.*—Brake levers must not be released by a kick or blow. When brake bands slip and fail to lock the wheels, they may be worn or merely greasy. Wash lining surfaces thoroughly with dry-cleaning solvent and adjust. No dressing of any kind is to be put on linings. When linings are worn beyond further service, which will be when no further adjustment is practicable or when

the copper rivets attaching them to the bands become loose, the brake band assembly is replaced.

c. To adjust brake bands.—Braking effect should be the same for both wheels. It should be possible to skid the wheels and to secure proper release of brake bands when brake lever is operated. When linings become badly worn, jack up axle to raise one wheel, disconnect adjusting nut from brake band end, and tighten nut on adjusting link a definite number of turns. Reconnect adjusting link to band and set brake. It should hold the wheel when a man of ordinary weight stands on outer end of one of the horizontal spokes. Then throw brake lever to extreme released position and see if brake band drags when wheel is turned. If it does, the band is too tight and must be readjusted. The brake lever should not come to the last notch in the segment when the brake is set. Leave a little movement in reserve for wear of the lining. Follow the same procedure with the other wheel.

d. Adjustment of automatic pole support.—In adjusting automatic pole support proceed as follows:

- (1) Clamp pole properly in pole socket.
- (2) Clean and lubricate all parts and see that they move freely.
- (3) Adjust compression of pole supporting spring (fig. 80) sufficiently to support a 20-pound weight suspended from pole at neck-yoke stop.

(4) The pole supporting spring (fig. 80) is compressed by tightening pole supporting spring rod nut (fig. 80). To do this, it is necessary to dismount the automatic pole support as outlined in paragraph 74 *a*.

(5) If the pole still droops, the lug of the pintle or the bottom of the lunette or both are worn. If this is the case, place sufficient shims between lug of pintle and lunette to bring pole to desired height. Take a piece of steel about $1\frac{1}{4}$ inches wide, the thickness of the shims, and long enough to forge around the lug and down and over main part of pintle proper. When the steel cools it will shrink on the pintle and make a close fit without the necessity of rivets or pins. In an emergency, a piece of horseshoe can be used successfully for this purpose.

(6) Method of adjusting the automatic pole support when vehicle is equipped with the modified pintle, M4A1, is to adjust the height of pole to approximately $29\frac{1}{2}$ inches by adding shims (three of which are furnished with each modified pintle), if necessary, under head of bolt measuring from a level floor to center of pole when vehicle is limbered with another vehicle. It will be noted that the square head

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of the adjusting bolt may be turned to a fresh wearing surface, and full service should thus be obtained before replacing the bolt.

76. Lubrication.—*a.* Life of vehicles depends to a great extent on proper lubrication. Particular attention should be given to the sliding and bearing surfaces, oil cups, oil holes, openings, or exposed surfaces providing means for lubricating the various bearing parts.

b. Care should be taken when cleaning oil and grease compartments to insure complete removal of all residue and sediment. Be certain that no dirt or other foreign matter drops into any of the lubricating passages or on the bearing surfaces.

c. Oil passages which become clogged should be cleaned with a piece of wire. Wood should not be used for this purpose as splinters are apt to break off and clog the passages.

d. If an oiler sticks in its seat and prevents passage of oil it can be loosened by means of a piece of wire pushed through the hole, care being taken not to damage the valve.

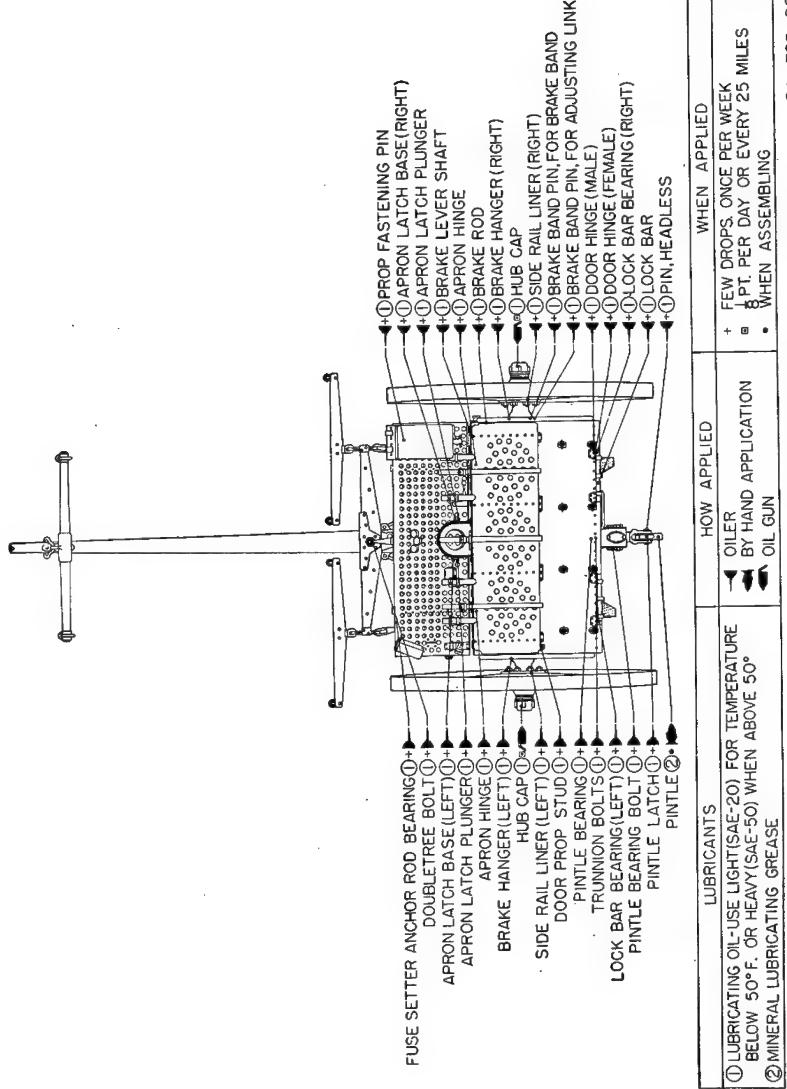
e. No lubricants will be used other than those issued or other than in the manner prescribed.

f. The oiling and greasing chart is based on the probable lubrication required for vehicles in continual service, as on the march. It should be used as a general guide only as requirements will vary according to conditions.

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75-MM GUN MATERIEL, M1897, AND MODIFICATIONS

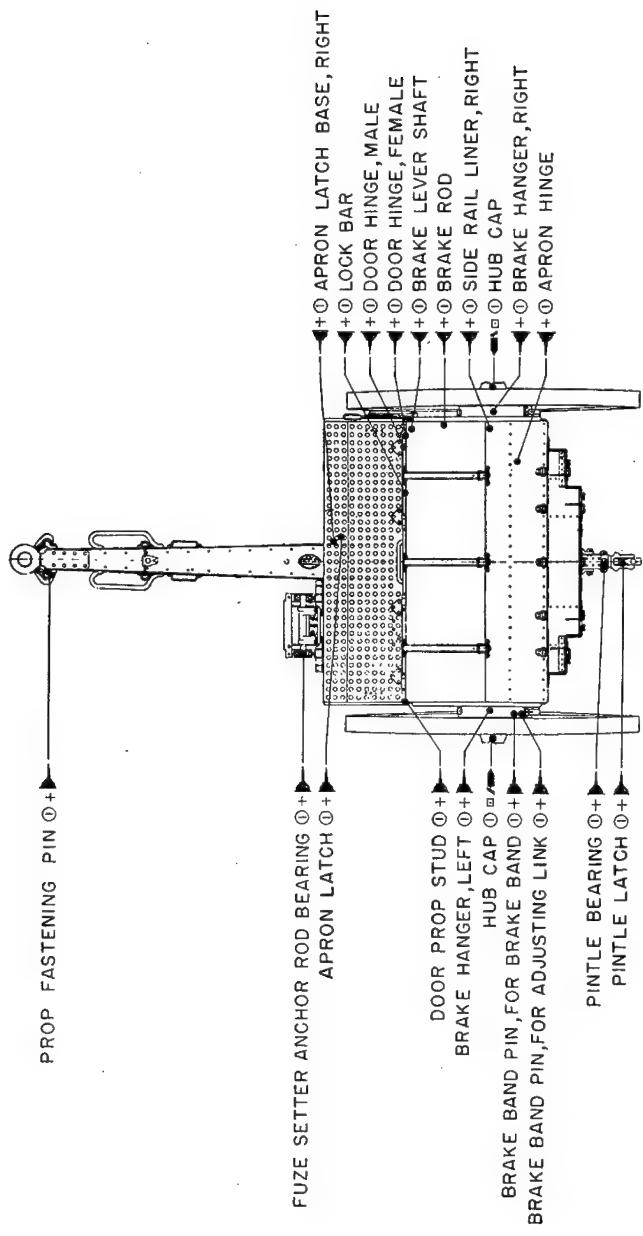
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LUBRICANTS	HOW APPLIED	WHEN APPLIED
① LUBRICATING OIL-USE LIGHT(SAE-20) FOR TEMPERATURE BELOW 50° F. OR HEAVY(SAE-50) WHEN ABOVE 50° ② MINERAL LUBRICATING GREASE	① OILER ② BY HAND APPLICATION ③ OIL GUN	① FEW DROPS ONCE PER WEEK ② 1/8 PT. PER DAY OR EVERY 25 MILES ③ WHEN ASSEMBLING

RA FSD 209

FIGURE 75.—Lubrication chart, limber M1918.



LUBRICANTS	HOW APPLIED	WHEN APPLIED
① LIGHT LUBRICATING OIL, SAE 20 OR EXTRA HEAVY LUBRICATING OIL, SAE 50	▲ OILER ■ OIL GUN	+ FEW DROPS ONCE PER WEEK □ $\frac{1}{8}$ PT. PER DAY OR EVERY 25 MILES

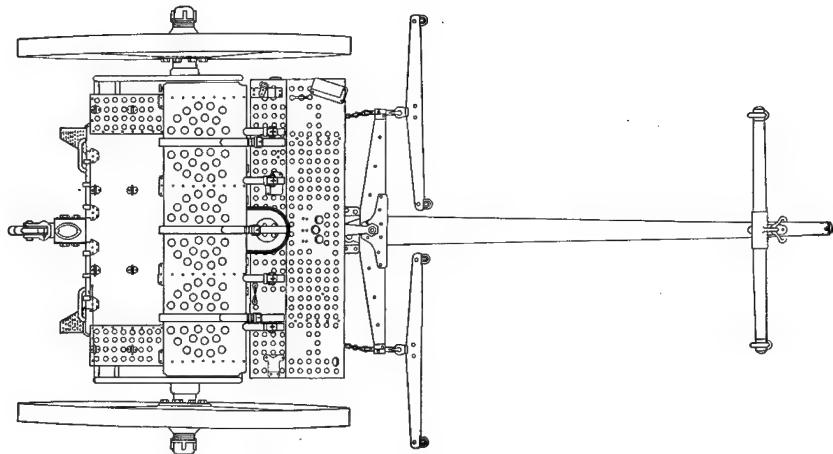
FIGURE 76.—Lubrication chart, caisson M1918.

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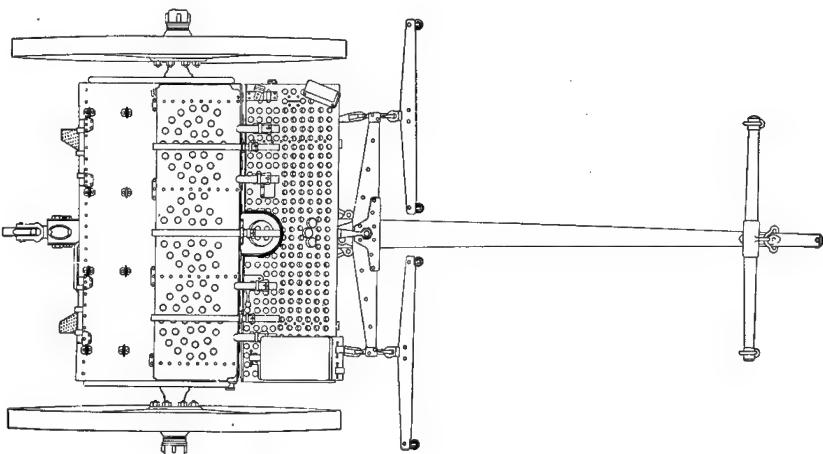
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75-MM GUN MATERIEL, M1897, AND MODIFICATIONS



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FIGURE 77.—75-mm gun carriage limber, M1918, assembly views.



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FIGURE 78.—75-mm gun caisson limber, M1918, assembly views.

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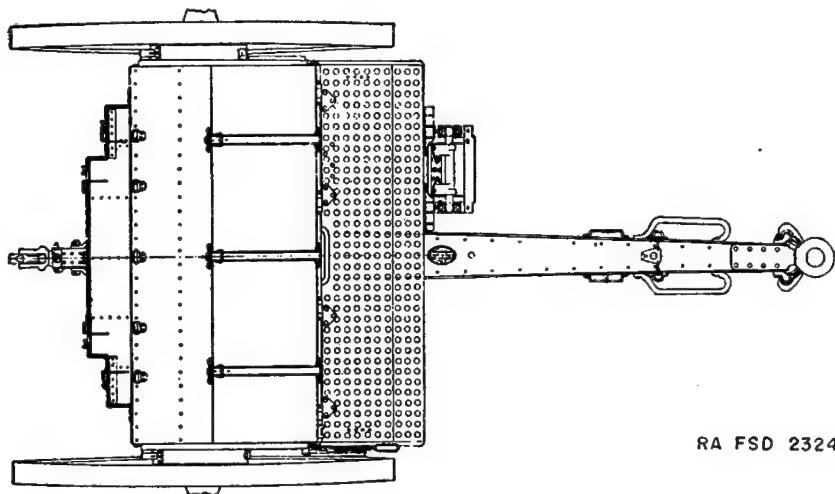


FIGURE 79.—75-mm gun caisson, M1918, assembly views.

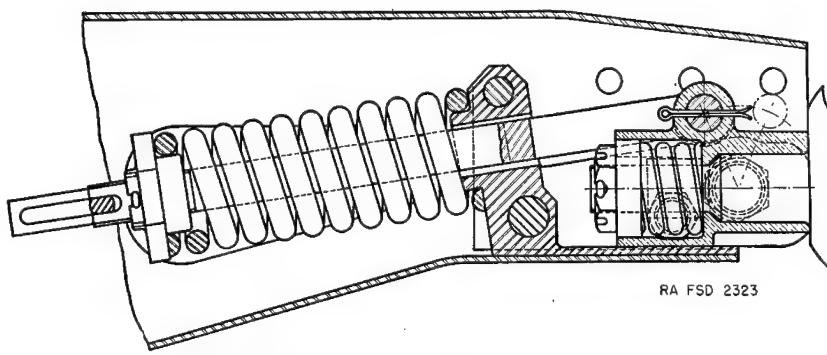


FIGURE 80.—Automatic pole support, sectioned view.

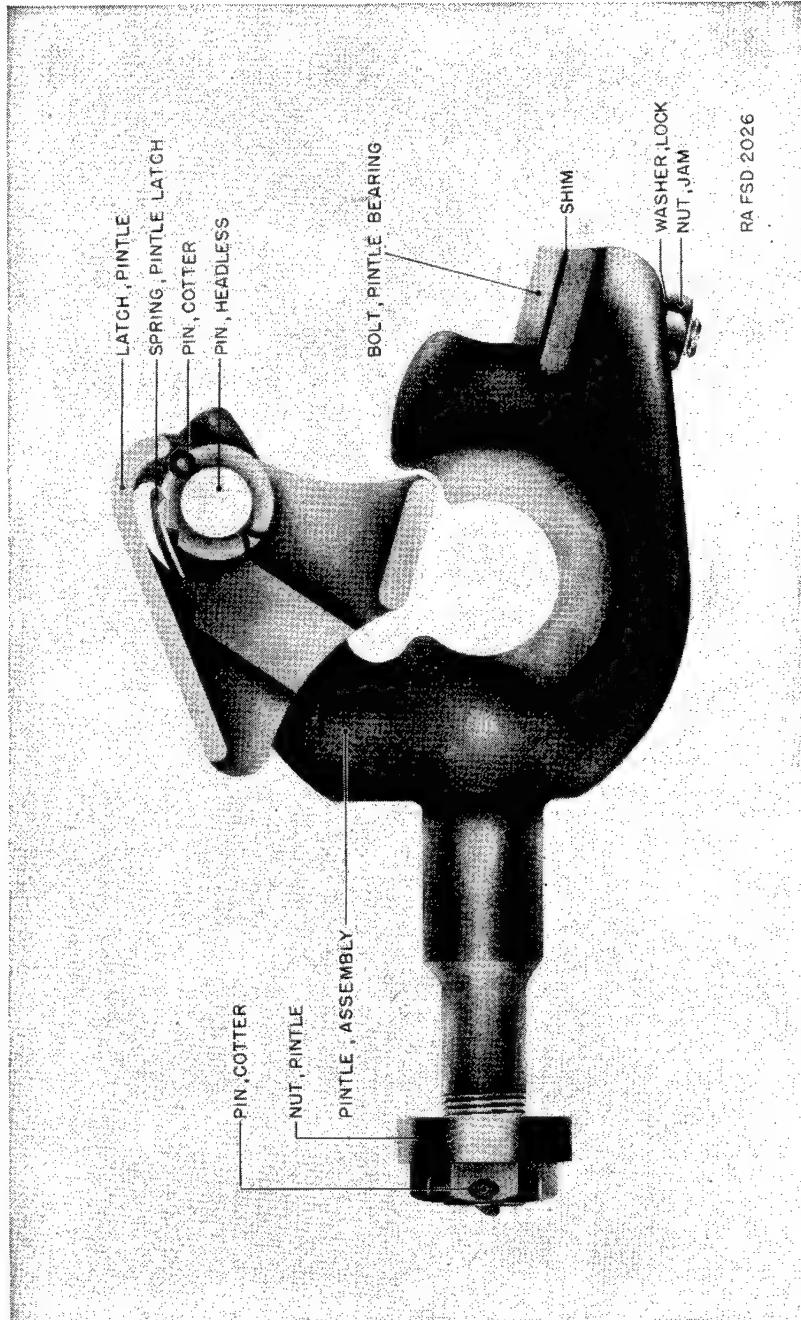


FIGURE 81.—Pintle, M4A1.

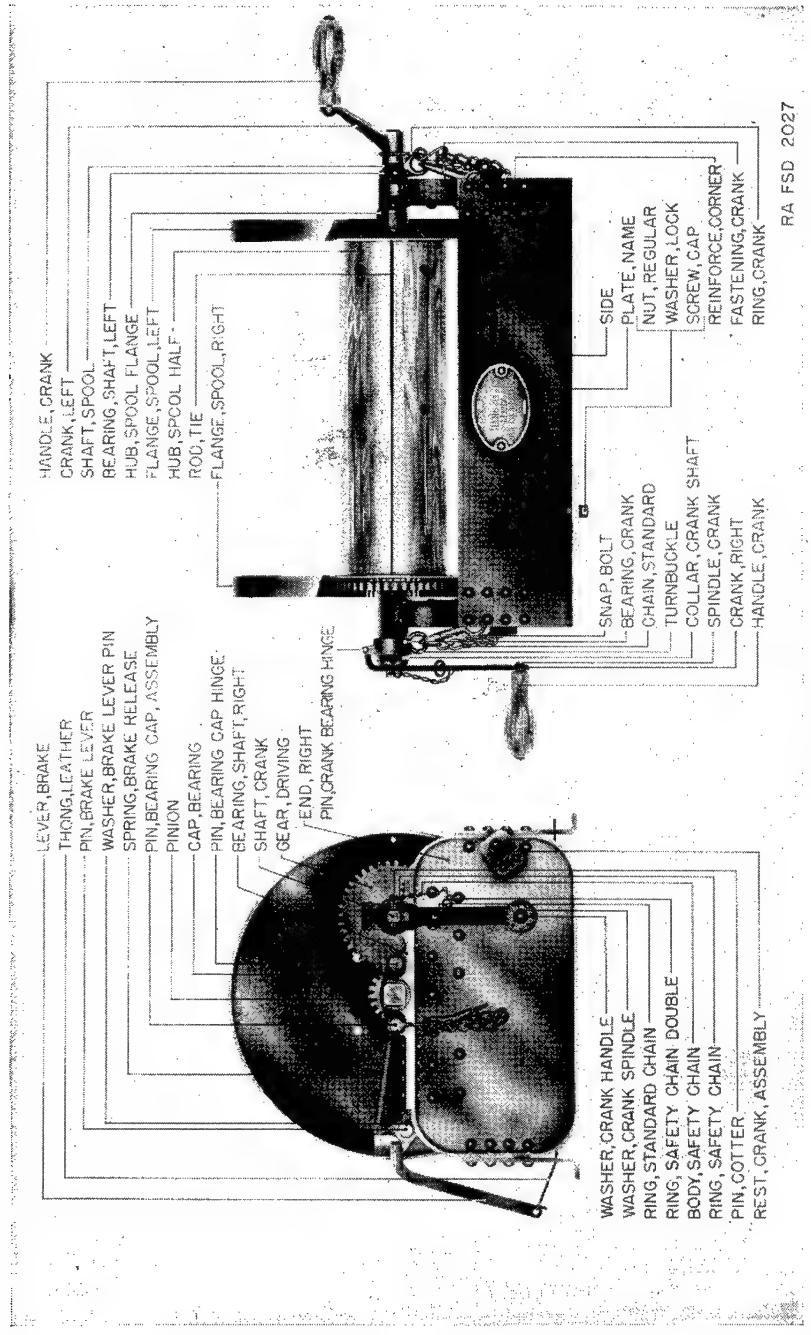


FIGURE 82.—Hand reel.

CHAPTER 6

SPARE PARTS AND ACCESSORIES

Paragraph

Spare parts -----	77
Accessories -----	78

77. Spare parts.—*a. General.*—Parts become unserviceable through breakage or through wear resulting from continuous usage. For this reason certain parts are provided as replacements. These parts are divided into two groups, namely, spare parts and basic spare parts. Basic spare parts are carried by the ordnance maintenance company for repair and maintenance of matériel and for issue to the using arm in replacement of spare parts used by that arm. Parts should be kept clean and lightly oiled to prevent rust.

b. Spare parts.—These are extra parts provided with the gun and carriage for replacement of those most likely to fail, and are for use by the using arm in making minor repairs. Sets of spare parts should be complete at all times as far as possible. Allowances of spare parts are prescribed in pertinent standard nomenclature lists.

78. Accessories.—*a. General.*—Accessories include the tools and equipment required for disassembling and assembling, for the cleaning and preservation of equipment, and what may be termed trouble tools such as axes, shovels, etc. They also include covers, containers, tool rolls, etc., necessary for storage and protection when the equipment is not in use or when traveling. Accessories, shown in figures 83 and 84, should not be used for purposes other than as prescribed and when not in use should be stored in places or receptacles provided. There are a number of accessories the names or general characteristics of which indicate their uses or application; therefore, detailed description or methods of use are not outlined herein. However, accessories embodying special features or having special uses are described below.

b. Accessories for gun and gun carriage.—(1) *Artillery gun book.*—The gun book (O. O. Form 5825) is used for the purpose of keeping an accurate record of the matériel. It must always remain with the matériel regardless of where it may be sent, and should be in the possession of the organization at all times. The battery commander is solely responsible for its custody and for the completeness of the records. The book is divided into record of assignments, battery commander's daily gun record, inspector's record of examination, as well

as forms to be filled out in case of premature explosions. It must also contain data of issuance of the matériel, to and by whom issued, and place where issued. If a new gun is installed on the carriage, all data in the old book with reference to sights, carriage, etc., must be copied into the new gun book before the old book is relinquished.

NOTE.—Record of assignment data must be removed and destroyed prior to entering combat.

(2) *Chests*.—Chests vary in sizes according to use. They may be of wood or steel. They are provided for storage and protection of equipment, cleaning material and small stores, and miscellaneous spare parts.

(3) *Covers*.—Covers are provided for the gun, carriage, and accessories when necessary; also for certain items of fire-control and sighting equipment. These covers are usually made of olive-drab cotton duck and are used for the protection of the matériel when not in use.

(4) *Equilibrator assembling nut*.—This is an elongated hexagon nut which is used to retain the equilibrator in an assembled unit while removing or replacing the equilibrator. This applies to the 75-mm gun carriages, M2A1, M2A2, and M2A3 only.

(5) *Filling and drain valve release*.—This release has a long shank which opens the filling and drain valve to allow the reserve oil to drain from the recoil mechanism.

(6) *Fuze wrench, M1*.—This wrench is used to tighten the fuze in the projectile before firing. It is used only with the older non-contoured types of fuzes.

(7) *Handspike*.—The handspike is used in traversing the gun by moving the carriage trail. It also fits into the ratchet housing of the firing jack of M2A1, M2A2, and M2A3 carriages.

(8) *Lanyard*.—The lanyard is composed of a certain length of sash cord with a handle at one end and a means of attachment to the firing mechanism at the other. It is used for firing the gun.

(9) *Lubricating gun and hose*.—The grease gun is of the screw type. It forces the lubricant through a hose attached to the nozzle. The gun is filled by hand, the handle being unscrewed to its maximum out position with screw cover removed. After filling, the screw cover is replaced and the gun is ready for use. The end of the hose is fitted with a pull-on coupling which fits on the button-head type fittings of the carriage.

(10) *Oil gun*.—A plunger type gun used to force oil into the desired bearings. It has a tapered nozzle to fit the oilers.

(11) *Oil screw filler*.—The oil screw filler is a high pressure hand pump used to replenish the recoil mechanism with oil. The oil is forced through the nozzle by means of a screw plunger. The oil screw filler is screwed into the filling hole by an adapter placed over the hexagon portion of the filler body. Extreme care should be used in order that the threaded nozzle of the filler is not broken or the threads distorted. The handle should be centered and both hands used in order to assure an even stroke.

(12) *Sponge and staff*.—The sponge and staff is for the purpose of swabbing and cleaning the bore of the gun. The sponge is a piece of carpet mounted on a cylindrical wooden block which slips over a bronze head. The head is bored for use as a rammer. It fits over the fuze of the shell when it is desired to remove the shell without firing. The staff is attached to the head by a coupling.

(13) *Tire pump and tire gage*.—The tire pump and tire gage are commercial types used respectively to inflate and to test the air pressure within the tire.

c. *Accessories for gun caissons and limbers*.—Accessories include ax, dust guard, pick mattock, paulin, hand reel, shovel, hatchet, oil can, picket rope, straps, pole prop, and fuze chests. Their nature and application are obvious.

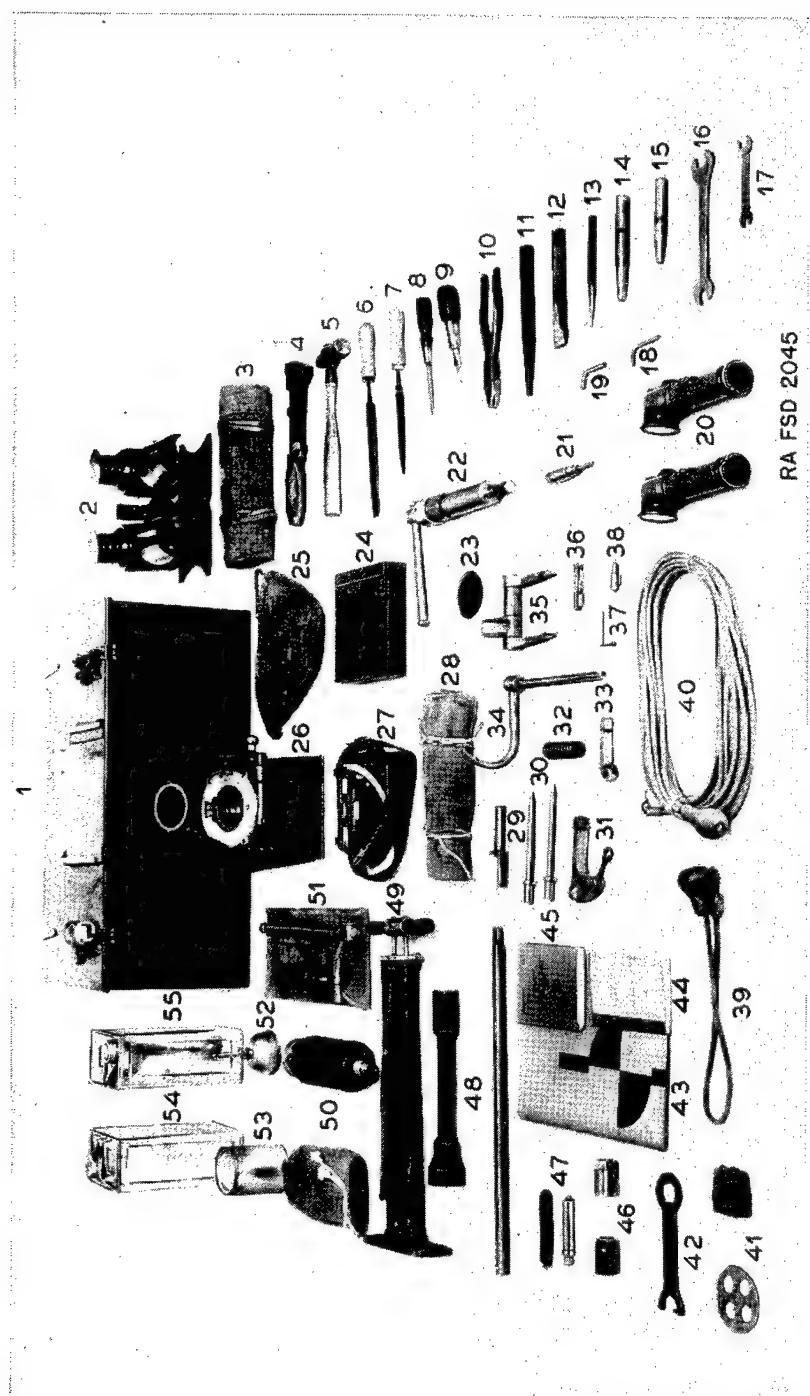


FIGURE 83.—Gun section chest, complete, for 75-mm gun carriage, M2A1, M2A2, or M2A3.

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Number	Item
1	Chest, gun section, M7.
2	Aiming post lamps (2).
3	Tool roll, M4, with contents as follows:
4	Wrench, screw, adjustable, knife-handled, 12-inch.
5	Hammer, machinist's, ball peen, 20-ounce.
6	File, A. S., hand, second cut, 8-inch, with handle 1 $\frac{1}{4}$ by 4 $\frac{1}{4}$ inches.
7	File, A. S., three-square, smooth, 6-inch, with handle 1 $\frac{1}{8}$ by 4 inches.
8	Screw driver, common, 3-inch (type A).
9	Screw driver, extra heavy duty, type C, style 2, wood insert handle, 5-inch.
10	Pliers, side cutting, flat nose, 8-inch.
11	Punch, drift, $\frac{1}{4}$ -inch point, 10 inches long.
12	Chisel, machinist's, hand, cold, $\frac{3}{4}$ -inch.
13	Punch, drive pin, standard, $\frac{1}{2}$ -inch point.
14	Drift, brass, taper, $\frac{1}{2}$ -inch point.
15	Drift, brass, taper, $\frac{3}{16}$ -inch point.
16	Wrench, engineer's, double-headed, alloy steel, $\frac{5}{8}$ and $\frac{3}{4}$.
17	Wrench, engineer's, double-headed, alloy steel, $\frac{5}{8}$ s and $\frac{1}{2}$.
18	Wrench, socket head setscrew, $\frac{3}{32}$ -inch, hexagonal.
19	Wrench, socket head setscrew, $\frac{1}{8}$ -inch, hexagonal.
20	Flashlight, type TL95 (Signal Corps) (2).
21	Release, filling and drain valve.
22	Filler, oil screw.
23	Lens, green, for aiming post lamp.
24	Chest, gunner's quadrant, M1.
25	Cover, bracket fuze setter.
26	Setter, fuze, bracket, M1916, with anchor.
27	Quadrant, gunner's M1, with carrying case.
28	Roll, spare parts, with contents as follows:
29	Rack, firing, assembly.
30	Pins, firing (2).
31	Hammer, firing, assembly.
32	Spring, firing rack.
33	Latch, breechblock, assembly.
34	Spindle, extractor.
35	Extractor.
36	Bolt, safety, assembly.
37	Pin, breechblock latch.
38	Pin, firing hammer.
39	Lanyard, assembly.
40	Lanyard, 50-foot.
41	Sight, bore, complete.
42	Wrench, fuze, M1.
43	Target, testing, paper (set of four).
44	Book, artillery, gun, 0.0. Form 5825 (blank).
45	Table, firing, 78-B-3.
46	Nut, assembling equilibrator (2).
47	Gage, tire, balloon, with case (each two sections).
48	Wrench, wheel stud nut, with handle (two per battery).
49	Pump, tire, 2-cylinder, with hose (each two sections).
50	Sponge, M9, with cover.
51	Gun, lubricating, pressure, screw handle type, 8-ounce, with cover and heavy duty lubricating hose, 15-inch, buttonhead type.
52	Oiler, S., copper-plated, $\frac{3}{8}$ -pint, 3-inch spout.
53	Grease, lubricating, mineral, medium, pound.
54	Oil, lubricating, class A, light, gallon.
55	Oil, recoil, heavy, low-pour point, gallon.

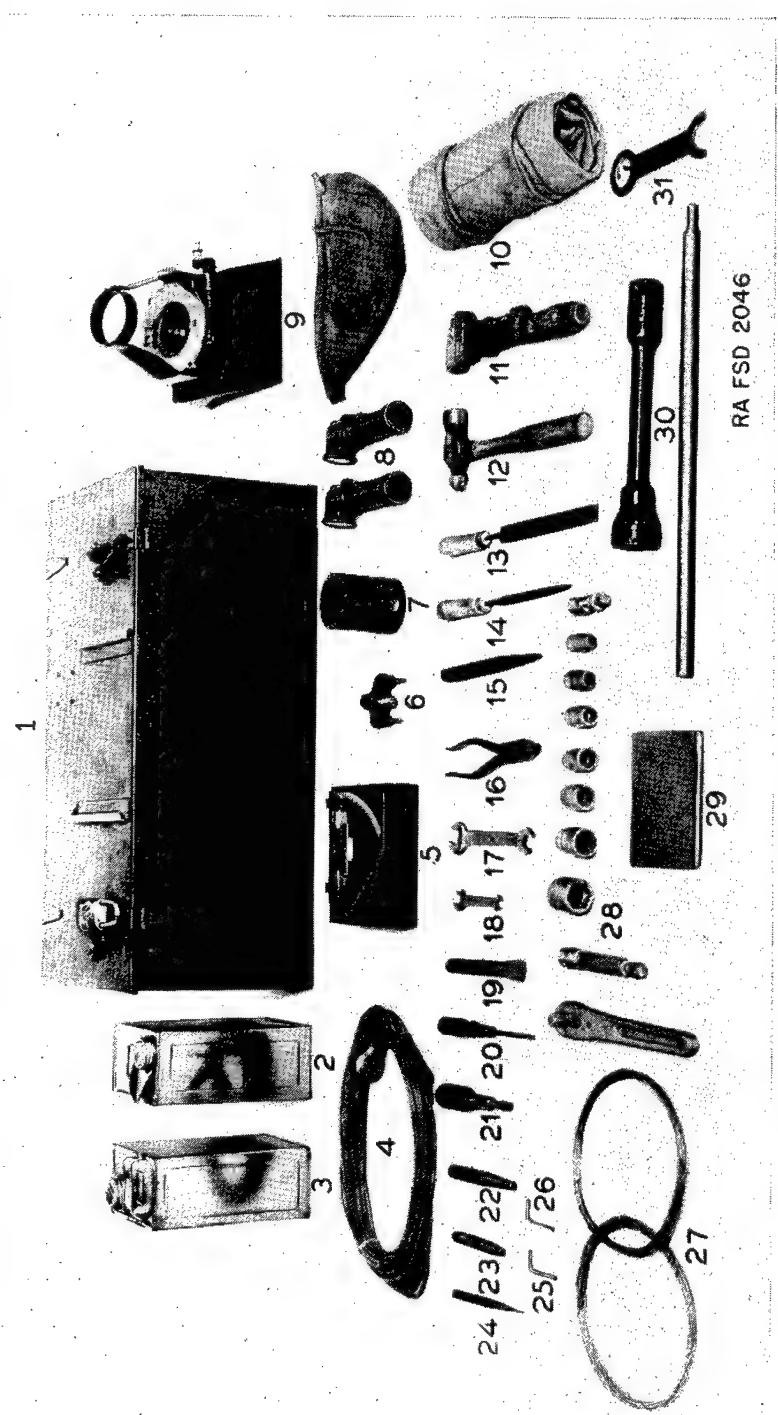


FIGURE 84.—Maintenance section chest, complete, for 75-mm gun carriage, M2A1, M2A2, or M2A3.

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Number	Item
1	Chest, gun section, M7.
2	Oil, recoil, heavy, low pour point, gallon.
3	Oil, lubricating, class A, light, gallon.
4	Lanyard, 50-foot.
5	Quadrant, gunner's, M1, with chest (spare).
6	Puller, gear.
7	Wrench, socket.
8	Flashlight, type TL95 (Signal Corps) (2).
9	Setter, fuze, bracket, M1916, with anchor, with cover.
10	Roll, tool, M4, with contents as follows:
11	Wrench, screw, adjustable, knife-handled, 12-inch.
12	Hammer, machinist's, ball peen, 20-ounce.
13	File, A. S., hand, second cut, 8-inch, with handle 1 $\frac{1}{4}$ by 4 $\frac{1}{4}$ inches.
14	File, A. S., three-square, smooth, 6-inch, with handle 1 $\frac{1}{4}$ by 4 inches.
15	Punch, drift, $\frac{1}{4}$ -inch point, 10 inches long.
16	Pliers, side cutting, flat nose, 8-inch.
17	Wrench, engineer's, double-headed, alloy steel, $\frac{5}{8}$ and $\frac{3}{4}$.
18	Wrench, engineer's, double-headed, alloy steel, $\frac{5}{16}$ and $\frac{1}{2}$.
19	Chisel, machinist's, hand, cold, $\frac{3}{4}$ -inch.
20	Screw driver, common, normal duty, 3-inch blade.
21	Screw driver, machinist's, extra heavy duty, wood insert handle, 5-inch blade.
22	Drift, brass, taper, $\frac{1}{2}$ -inch point.
23	Drift, brass, taper, $\frac{5}{16}$ -inch point.
24	Punch, drive pin, standard, $\frac{1}{16}$ -inch point by 4-inches long.
25	Wrench, socket head setscrew, $\frac{1}{4}$ -inch, hexagonal.
26	Wrench, socket head setscrew, $\frac{5}{32}$ -inch, hexagonal.
27	Wire, copper, soft, 0.032-inch diameter, pound (2).
28	Wrench-set, socket, hexagonal openings, complete, with 1 ratchet, 10-inch; 1 grip, handy, 6-inch; 7 sockets, heavy duty, 1 each, sizes $\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $1\frac{1}{16}$, 1, and $1\frac{1}{8}$; and 1 universal joint.
29	Table, firing, 75-B-3.
30	Wrench, wheel stud nut, with handle.
31	Wrench, fuze, M1 (spare).

CHAPTER 7

SUBCALIBER EQUIPMENT

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79. General.—*a.* Subcaliber equipment is issued for training. For this purpose, guns and carriages covered in this manual mount a 37-mm gun and recoil mechanism on suitably fitted mounts properly adjusted to the respective matériel. Although handling and loading as well as range obtained differ from those of the respective pieces, results obtained are adequate for instructional purposes.

b. The 37-mm gun, M1916, with its recoil mechanism, is used as a subcaliber weapon for the 75-mm gun, M1897, mounted on carriages, M1897, M1897MIA2, or M1897A4, and for the 75-mm gun, M1897A4 or M1897A2, mounted on carriages, M2A1, M2A2, or M2A3. The subcaliber gun with recoil mechanism is firmly affixed to the 75-mm gun matériel by mounts designed and properly fitted and adjusted in alinement with bore and sights of the respective major equipment.

80. Description of breechblock and breech mechanism.—*a.* **General.**—The breechblock is Nordenfeld type somewhat similar (except in size) to that of the 75-mm guns listed above (see fig. 85). The breechblock screws into the breech ring and rotates through an angle of 156° about its axis. The axis of the breech recess is below the axis of the bore. The breechblock is operated by the breechblock lever which, when moved to the left, causes the breechblock to rotate, thus carrying the eccentric part to a position in line with the bore,

and also operates the extractor which extracts and ejects the cartridge case. The breechblock closes by moving the lever to the right, which places the firing pin in line with the percussion cap in the base of the cartridge case, and releases the safety bolt.

b. Safety bolt.—The safety bolt prevents firing of the gun if the breechblock is not fully closed.

c. Firing mechanism.—The firing mechanism consists of firing pin, firing pin spring, rocker, rocker pin, rocker pin latch, and rocker plunger which are housed in the breechblock. When the trigger crank lever is pressed down the firing pin strikes the percussion cap, thus firing the gun.

81. Description of recoil mechanism.—*a.* The recoil mechanism is located in the cradle underneath the gun, and upon it the gun slides during recoil and counterrecoil. It consists of the recoil mechanism, the counterrecoil mechanism, and the counterrecoil buffer (see fig. 86).

b. The recoil mechanism is for the purpose of controlling the force created by firing and to check movement of the gun in a gradual manner. The counterrecoil mechanism is for the purpose of returning the gun into battery in order that it may be fired again. The counterrecoil buffer is for the purpose of slowing down and stopping the counterrecoil action without injury to the system.

82. Breech mechanism.—*a. Operation.*—*(1) To cock.*—Place the palm of hand against cocking handle of striker and push it forward until it latches. After the first shot the mechanism is automatically cocked. If round is not to be fired, remove it from gun. Do not uncock while gun is loaded as the mechanism must be cocked before it can be opened.

(2) To open breech.—*(a)* Rotate breechblock lever to left as far as it will go (fig. 85).

(b) The gun has no breechblock latch to hold breechblock in open or closed position. However, if the firing mechanism has been tripped, it will be necessary first to cock mechanism before breech may be opened.

(3) To load.—Insert round of ammunition, pushing cartridge case in as far as allowed by extractor.

(4) To close breech.—*(a)* Grasp breechblock lever and rotate it to right as far as it will go.

(b) During first part of movement a ramp on front of breechblock pushes cartridge case in flush with face of breechblock. It is pushed home by forward movement of breechblock in the breech ring threads.

b. Disassembly and assembly.—*(1) To dismount breechblock.*—*(a)* Cock piece with left hand by means of cocking handle on striker rod.

Remove breechblock lever with right hand by grasping handle with the fingers and pressing breechblock lever release pin cap with the thumb.

(b) Take out extractor pin by pressing extractor pin latch toward breech with left forefinger and pulling it out to right with the right hand. Extractor will drop down until its heel clears extractor cam.

(c) Unscrew breechblock, grasping it firmly in right hand and supporting it with left hand, and remove it by unscrewing to left.

(2) *To replace breechblock.*—(a) See that breech recess, extractor, and threads of breechblock are thoroughly cleaned and lightly oiled. Set extractor in its seat but do not put in extractor pin.

(b) Cock.

(c) Screw breechblock home.

(d) Put breechblock lever in place.

(e) Raise extractor by pushing upward on its heel from under block and put extractor pin in from the right until extractor pin latch springs out and secures the pin.

(f) Uncock by pressing down trigger lever with right thumb while using pressure against cocking handle with left hand to prevent too fast movement of striker.

(3) *To dismount extractor.*—(a) Dismount breechblock as directed in (1) above.

(b) Withdraw extractor by inserting left forefinger in mortise in base of breech ring, raising extractor a little and grasping it with thumb and finger of right hand.

(c) To assemble extractor see (2)(e) above.

NOTE.—Do not attempt to unscrew or screw in breechblock without first removing extractor pin.

(4) *To dismount rocker, rocker plunger, and firing pin.*—(a) Mechanism should be cocked or breechblock dismounted.

(b) The rocker pin is retained in its seat by the free end of the spring entering the groove in outer end of rocker pin. This spring may become stuck with paint and should be freed by scraping paint around edge before attempting to remove rocker pin.

(c) Head of rocker pin projects at one side of the port. Place a small bronze drift against the projecting head and with light taps drive pin into the port. Rocker is then free and when removed exposes the firing pin, which will be pushed out by its spring and the rocker plunger, all of which may then be taken out.

(5) *To assemble rocker, rocker plunger, and firing pin.*—(a) Clean and lubricate all parts; put in rocker plunger, firing pin spring, and firing pin.

(b) Hold rocker down in its seat with thumb until rocker pin can be started through. Push pin home and see that rocker pin latch springs into the groove.

(6) *To remove piston cross head key.*—Disengage striker. Press up on piston cross head key latch and push key out to left.

(7) *To assemble piston cross head key.*—Clean, examine, and lubricate parts and push key in place with trigger crank lying in front of long arm of sear. See that safety bolt properly engages depending arm of sear before piston cross head key is pushed fully home. Failure to have safety bolt in proper position will prevent cross head key from being fully pushed in, and an attempt to force it will cause damage to the sear.

(8) *To disassemble striker mechanism.*—Having removed piston cross head key, draw gun back about 8 inches and push striker to its extreme forward position to loosen striker rod nut setscrew and unscrew striker rod nut. Allow spring to expand slowly and push striker rod out. Clean all parts. Free height of the striker spring should be 6.81 inches. If it is as much as 0.5 inch less than this, replace it with a new spring.

(9) *To assemble striker mechanism.*—Thoroughly slush striker spring and striker rod with light lubricating oil. Place striker spring over rod and insert them in striker housing. Push striker to extreme forward position and screw nut until front edge of nut is about flush with front end of striker rod, taking care that striker rod nut setscrew comes opposite its keyway in the striker housing. The stroke of the striker rod may be lengthened by unscrewing striker rod nut a few turns. The setscrew must not be omitted and must be well set in so that it does not strike the bottom of the keyway.

83. Gun and cradle disassembly and assembly.—*a. Disassembly.*—(1) Remove flash hider, if present, by taking out flash hider collar clamp bolt.

(2) Release striker and take out piston cross head key by pressing up on its latch and pushing it out to left.

(3) Draw gun back carefully off cradle by grasping muzzle with the left hand and breech with the right.

b. Assembly.—(1) See that gun slides and piston cross head are thoroughly cleaned and lubricated.

(2) Insert gun from rear, carefully maintaining alinement to avoid jamming gun slides.

(3) Replace piston cross head key.

84. Inspection.—Careful and frequent inspection should be made of the matériel to discover any parts which need attention or adjustment.

Parts to be inspected

a. Gun and recoil mechanism as a unit.
b. Breechblock.

c. Firing mechanism.

d. Barrel.

e. Recoil mechanism.

Points to observe

a. General appearance. Condition of paint. Try ejection with empty shell case.

b. Rotate breechblock from right to left and back several times, noting whether there is any stiffness or binding. Depress breechblock lever release pin cap and pull out breechblock lever. Remove extractor pin. Then rotate breechblock in a counterclockwise direction until threads on breechblock are disengaged from threads in barrel and examine threads on breechblock for burs and rough surfaces. Note firing pin hole in face of breechblock, depress rocker plunger, and note how far firing pin protrudes. With rocker plunger fully depressed, firing pin should protrude approximately $\frac{1}{8}$ inch. Remove rocker pin, turn breechblock over and allow rocker plunger, firing pin, and firing pin spring to drop out. Note these parts for rust and burred surfaces. Tension of firing pin spring, free length, $2\frac{5}{32}$ inch. Try tension of breechblock lever latch spring.

c. Try tension of striker spring and sear plunger spring. Try action of trigger crank and trigger crank lever. Trigger crank plunger should have tension enough to hold trigger crank in place. Note sear and sear notch for burs or worn surfaces.

d. Note threads in breech for burs and rough surfaces. Chamber and barrel should be free from pits and rust. Remove piston cross head key and slide barrel back to insure that jacket shoe and recoil ways are free from burs.

e. (1) Remove barrel assembly from recoil mechanism and note front and rear caps for oil leaks, and leaks at piston rod packing washer. Check quantity of oil in recoil mechanism.
(2) Make a retraction test. A simple retraction test may be made by manually re-

tracting the gun, blocking it with a piece of wood about 10 inches long, and then pulling out the block with a cord or wire. The gun should return to battery quickly, but without shock.

85. Malfunctions.—*a.* The gun may under certain conditions either fail to return completely to battery or may return too suddenly with a shock which will tend to destroy the aim. The firing mechanism may jam, or there may be a defective discharge, or failure to eject empty cartridge case properly.

b. Incomplete return to battery is evident when the firing mechanism does not cock, or the cocking is not sufficient to produce discharge of the next shot. This may be caused by weakened counter-recoil springs, scored or scratched jacket shoe guides, a bent recoil cylinder, or an excess of oil in the recoil mechanism, which is due to expansion of the oil caused by excessive friction accompanying continued firing. In the latter case a little oil may be let out of the recoil mechanism by unscrewing the drain plug located on the rear right side of the cradle. If it is thought that the condition of the guides is causing the difficulty, the gun should be dismounted and the guides examined for traces of excessive friction, scratches, fouling, etc. This may be remedied by careful use of a fine file and thorough cleaning and oiling. Test the operation of the gun in the slides before replacing the piston cross head key.

c. Sudden return into battery position with a jarring impact is due to incomplete buffing at the end of counterrecoil or to insufficient oil in the recoil mechanism. Ordinarily addition of a little oil will remedy both of these conditions. To do this, remove filling plug at front of cradle and inject sufficient oil by means of the oil gun.

d. Where trigger crank lever cannot be depressed sufficiently to operate firing mechanism, the malfunction can usually be attributed to incomplete closure of the breech which causes the safety mechanism to lock the sear. The cartridge case should be examined for damaged rim or other defects tending to prevent its insertion in the chamber. Another shell may be tried. If the loading is not cause of the difficulty, examine chamber for dirt or fouling and trigger mechanism for broken or damaged parts or foreign matter which has become caught in the mechanism. Broken or damaged parts should be replaced.

e. Failure to fire is due either to a defective primer, a weakened striker spring, a worn or broken firing pin, or dirt in the firing pin

recess. If two percussions are frequently necessary to produce discharge, the striker spring has either become weakened and should be replaced, or it is clogged with dirt and hardened grease so that it cannot function properly. If no defect can be found in the firing mechanism and the shell does not fire after three percussions wait for 2 minutes, then replace it with another as the primer is defective.

f. Defective extraction may occur when cartridge case tends to stick in the chamber, when edge of chamber is burred or fouled with powder, or when extractor is damaged or broken. A poor cartridge case may cause sticking in the chamber due to expansion, in which case the hand extractor should be used to complete extraction. Careful use of a fine file will correct sticking due to burring of chamber. If extractor is broken or damaged it should be replaced.

g. The various causes of irregularity in operation are—

- (1) *Failure to fire.*—(a) Breech not closed.
(b) Broken sear.
(c) Gun not cocked.
(d) Defective ammunition.
(e) Defective firing pin.
(f) Weak striker spring.
- (2) *Failure to extract.*—(a) Breech opened slowly.
(b) Dirty chamber.
(c) Extractor pin out.
(d) Burred chamber.
(e) Swollen cartridge case.
(f) Defective extractor.
- (3) *Failure to return to battery.*—(a) Too much oil in recoil mechanism.
(b) Dirty slides.
(c) Bent shoes or slides.
(d) Burred shoes or slides.
(e) Defective cradle.
- (4) *Breech will not open.*—(a) Gun not cocked due to—
 1. Worn or broken sear.
 2. Worn or broken shoulder on striker rod.
 3. Defective sear plunger and springs.
 4. Gunner failed to release trigger crank lever.
(b) Firing pin stuck in primer caused by—
 1. Burred rocker.
 2. Defective primer.

86. Care and preservation.—*a. Gun.*—The matériel should be kept in perfect condition and thoroughly cleaned and oiled. Only

such cleaning and preserving materials as are issued for this purpose will be used. It is especially important that all parts of the gun be kept free from rust. The following instructions for cleaning these parts will be strictly observed.

(1) Bore and chamber of the gun require particular attention and will be thoroughly cleaned within 1 hour after firing. To prepare cleaning solution dissolve one part, by volume, of soda ash in four parts of water. Hot water, not boiling, is better than cold. Place barrel on a rack or table, remove breechblock and extractor, and clean bore thoroughly with the soda ash solution. This can best be done by mixing the solution in a bucket. Place bucket under breech, dip cleaning brush in solution, and work it briskly back and forth in the bore until clean. Dry bore thoroughly, using burlap or cloths, Then oil bore with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047.

(2) Breechblock and firing mechanism will be thoroughly cleaned. All parts and recesses and breechblock threads will be lightly oiled with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047.

(3) Trigger mechanism will be kept free from dust and foreign matter and after use, all parts will be carefully wiped dry and a drop of light lubricating oil put on striker bearings, trigger bearings, and safety bolt.

(4) Gun slides will be cleaned and freely oiled with oil, lubricating, SAE 20, Navy Symbol 3050 or 1047.

b. Recoil mechanism.—To fill an empty recoil mechanism $2\frac{3}{4}$ pints of oil, or 21 oil gun fills, are required. Heavy recoil oil only is issued for use in the recoil mechanism.

(1) *Procedure.*—Rear end of cradle should be higher than the front.

(a) Fill oil gun.

1. Unscrew nozzle of oil gun.
2. Pull plunger back.
3. Fill oil gun with heavy recoil oil.
4. Replace nozzle.
5. Push up plunger gently to force out the air.

(b) Remove filling plug.

(c) Screw oil gun into filling hole.

(d) Remove drain plug.

(e) Push plunger of oil gun in slowly, and at the same time watch for the escape of oil from the drain hole. When oil runs out free of air bubbles recoil mechanism is full.

(f) Remove oil gun. Before replacing the filling and drain plugs let about two teaspoonfuls of oil escape, then screw the two plugs in tightly. This is necessary as the expansion of oil during prolonged fire may interfere with the complete return of the gun to battery.

(2) *Adjustment*.—No adjustment of recoil mechanism by the using arm is permitted. Report to ordnance personnel.

87. Precautions.—The precautions which must be observed before, during, and after firing are—

a. Before firing.—(1) Bore is clean and dry.

(2) Recoil mechanism is correctly filled.

(3) Sight is clean, adjusted, and lock nuts tight.

(4) All parts are functioning properly.

(5) Spare parts set is complete.

(6) All moving parts are oiled.

(7) Make retraction test (see par. 84e(2)).

b. During firing.—(1) In case of a misfire recock, relay, and make three attempts to fire. If failure continues wait 2 minutes before opening breech.

(2) Release trigger crank lever promptly.

c. After firing.—(1) Clean piece thoroughly within 1 hour after firing.

(2) Examine gun and cradle for worn, loose, or broken parts.

88. Practices to be avoided.—Certain practices which must be avoided in order to maintain efficient operation are—

a. No attempt should be made to repair or disassemble recoil mechanism except by ordnance personnel. Using arm may fill or drain it as necessity requires.

b. Avoid working trigger mechanism when there is no cartridge in the chamber, and do not attempt to force trigger crank lever when breech is not completely closed as the sear is locked by the safety bolt on underside of breech ring.

c. Breechblock should not be moved when striker is not cocked.

d. Walls of recoil cylinder and of striker housing attached to cradle are relatively thin. Therefore dropping the cradle may dent them and cause internal interferences. Clamping the cradle in a vise without proper holding blocks will also tend to distort and ruin it.

89. Lubricating instructions.—*a.* Proper lubrication of bearing surfaces is necessary if the mechanism is to function smoothly and give long service. The 37-mm gun matériel has very few oil holes

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or special lubricating fittings, yet it requires frequent oiling of certain bearings.

b. The following chart gives locations where lubrication will be necessary, kind of lubricant, amount required, and frequency and method of application required for 37-mm gun matériel in active service.

Lubricating chart, 37-mm gun matériel, M1916

Part	Method	Kind	Remarks
Bore-----	Slush-----	Oil, lubricating, SAE 20, Navy Symbol 3050 or 1047.	After firing or weekly. First clean bore. See para- graph 86a(1).
Breechblock-----	Spread oil on threads.	do-----	Daily. Unscrew breechblock.
Firing pin-----	Drops at contact surfaces.	do-----	D a i l y . W h i l e breechblock is dis- mounted.
Extractor and ex- tractor pin.	do-----	do-----	Do.
Safety bolt-----	Drops at ends of bracket.	do-----	Do.
Striker rod-----	do-----	do-----	Do.
Sear-----	Drops at bearing surface.	do-----	Do.
Piston cross head key.	Drops at contact surfaces.	do-----	At assembly.
Striker spring-----	Slush-----	do-----	Do.
Gun slides-----	Cover bearing sur- faces.	do-----	Dismount gun. See paragraph 83a.
Trigger crank-----	One drop at each end of bearing.	do-----	Once per week.

90. Gun mounts.—a. *Description and operation.*—(1) *37-mm subcaliber mount, M2* (fig. 87).—The assembled mount is composed of a front and rear support. These supports form a rigid mounting for the 37-mm gun and recoil mechanism when mounted on the 75-mm gun, M1897. The front support consists of a bracket with U-bolts, nuts, and adjusting screws. The bracket fits around the 37-mm gun recoil mechanism and the U-bolts around the 75-mm gun barrel. The rear support is composed of a left and right bracket with the necessary studs, nuts, and adjusting screws. This support fits around the 75-mm gun barrel just in front of and against the jacket and onto the trun-

nions of the 37-mm gun recoil mechanism. The rear support is sufficient to withstand all forces of firing. The front support is necessary to permit alinement of the 37-mm gun with the 75-mm gun.

(2) *37-mm subcaliber mount, M7* (fig. 88).—The mount, consisting mainly of a three-legged bracket, forms a rigid support for the 37-mm gun and recoil mechanism on the 75-mm gun carriage, M2A1, M2A2, or M2A3. The three-legged bracket straddles the rear portion of the 75-mm gun, M1897A2 or M1897A4, and is attached to the support directly over the cradle trunnion by two cap screws, the front legs being bolted to the cradle of the 75-mm gun recoil mechanism by means of cap screws, lock washers, and nuts. A small triangular bracket when bolted to the support bracket forms a trunnion bearing which is provided with fillister head cap screws and jam nuts to retain the gun cradle in position, and also provides a means of adjustment for deflection. The two fillister head cap screws and the adjusting screw with their jam nuts at the front of the bracket provide a means of adjusting the 37-mm gun when bore sighting on the testing target.

(3) *37-mm subcaliber mount, M8* (fig. 89).—The mount, consisting mainly of a four-legged bracket, forms a rigid support for the 37-mm gun and recoil mechanism on the gun carriages, M1897MIA2 and M1897A4. The four-legged bracket straddles the rear portion of the 75-mm gun, M1897, and is attached by means of pins to the supports which are fastened by screws to the cradle of the 75-mm gun recoil mechanism. A small triangular bracket when bolted to the support bracket forms a trunnion bearing which is provided with fillister head cap screws and jam nuts to retain the gun cradle in position and to provide a means for adjustment for deflection. The two fillister head cap screws and the adjusting screw with their jam nuts at the front of the bracket provide a means of adjusting the 37-mm gun when bore sighting.

b. Assembly and disassembly.—(1) *37-mm subcaliber mount, M2* (fig. 87).—(a) In assembling and mounting supports, gun, and recoil mechanism on the 75-mm gun, the first operation is to place the front bracket on the 37-mm gun recoil mechanism. This is accomplished by slipping it over front end of recoil mechanism, counterbored part to front, and tightening adjusting screws slightly.

(b) Gun and recoil mechanism are placed upon the muzzle end of the 75-mm gun with the trunnions of the 37-mm gun approximately 1 inch in front of the 75-mm gun jacket. The U-bolt is placed around the barrel of the 75-mm gun and up through the holes provided in the front bracket, and the nuts screwed on and slightly tightened.

(c) The rear brackets, left and right, form the rear support when assembled. This is assembled against the front end of the jacket of the 75-mm gun and over the trunnions of the 37-mm gun recoil mechanism. The adjusting cap screws are tightened slightly against the trunnions and adjustments made. The long studs are then inserted in the brackets and nuts placed thereon. These are tightened sufficiently to hold gun and recoil mechanism in position.

(d) After rear support is properly aligned and adjusted, nuts and adjusting screw are tightened. Front support is in its proper position when its adjusting screws are tangent to the flange of the front cap (fig. 87).

(2) *37-mm subcaliber mounts, M7 and M8.*—(a) Place subcaliber mounts in positions as shown in figures 88 and 89, respectively. The mounts are fastened by means of cap screws, or pins and supports. Release tension on jam nuts of adjusting screws at front of bracket. Remove small triangular bracket by disassembling nuts and lock washers from screws.

(b) Lift 37-mm gun and recoil mechanism and insert front end of recoil cylinder through band on front end of support bracket. Place trunnion of recoil mechanism in trunnion bearing of support bracket. Assemble small triangular bracket over recoil mechanism trunnion, and bolt it in place. Tighten fillister head cap screws in trunnion bearing and those on the band of front end of bracket just sufficient to retain the 37-mm gun in position.

(3) *Disassembling.*—Disassembling is accomplished by loosening the adjusting screws and removing the supports. This requires no further explanation as the procedure is elementary.

c. *Care and preservation.*—Repairs to the 37-mm subcaliber mounts will be minor in nature and will involve only the removal of burs when necessary and the replacement of parts. When a subcaliber mount is dismounted all screws, nuts, and lock washers should be assembled to the mount to avoid their being lost.

91. *Bore sighting.*—Verification of the 75-mm gun sights having been accomplished as described in chapter 3, section II, it only remains to align bore of the 37-mm gun with that of the 75-mm gun. Procedure is as follows:

a. Make a testing target by wrapping two pieces of black tape of equal width around the aiming post. For the M2 mount, lower edges should be exactly 10 inches apart; for the M7 mount, lower edges should be exactly 14.375 inches apart; and for the M8 mount, lower edges should be exactly 12.265 inches apart. By use of aiming post as

a testing target it will not be necessary to level the 75-mm gun, as the aiming post can be canted to conform to the angle of the gun so that the vertical line of bore of 75-mm gun will coincide with the side of the aiming post. The testing target should be placed about 50 feet from the gun.

b. Use bore sights to line up bore of 75-mm gun with lower edge of lower tape on aiming post.

c. Use bore sights for 37-mm gun and sight it on lower edge of upper tape on aiming post.

d. All adjustments of the 37-mm gun upon testing target are made by adjusting screws in brackets that encircle recoil cylinder, and those in trunnion bearings.

e. When proper adjustment has been made set jam nuts up tight.

92. Miscellaneous operations.—*a. Counterbalancing 75-mm gun when used with M2 mount.*—With the 37-mm gun, recoil mechanism, and subcaliber mount in place, the increased force required to operate the 75-mm gun angle of site and elevating mechanisms without counterbalance is negligible. Counterbalance is not necessary for smooth operation, but desirable on account of field artillery procedure which calls for elevation of the breech as the last movement before firing. A weight of 66 pounds is necessary to counterbalance the weight of the 37-mm gun with the 75-mm gun in battery. This can be obtained in part by the use of the drill cartridge, and for the additional weight required small sandbags may be laid on or attached to the breech. No special equipment for this purpose will be provided. Empty cartridge cases filled with the required amount of lead, if available, make excellent counterweights. Withdrawing oil from the recuperator of the carriage in order to push the gun to the rear to overcome the weight of the subcaliber mount is prohibited. An excess reserve of recoil oil must be established in the primary weapon before firing the subcaliber gun.

NOTE.—Counterbalancing is not necessary with the M7 and M8 mounts.

b. Functioning.—The normal position for operating the subcaliber equipment is from the right side. Caution is required on the first round as the gunner is compelled to reach across the gun to cock the firing mechanism. Subsequent firing automatically cocks it.

c. Witness line.—After the 37-mm gun is alined, marks should be inscribed on the 75-mm gun with a chisel or other sharp-edged tool to aid further mounting of the subcaliber equipment. Witness lines are used only with the M2 mount, as the M7 and M8 mounts are located by means of their fixed brackets.

d. Care and maintenance.—When firing subcaliber, the primary tube should be covered to prevent damaging the paint. When firing with the M2 mount, an excess reserve should be placed in the recoil system of the 75-mm carriage, and a counterbalance should be used. When traveling, the 37-mm gun and recoil system should be removed. After firing both bores should be cleaned.

93. Spare parts and accessories.—*a. Spare parts.*—The spare parts issued with the subcaliber equipment are those which are liable to fail and which may be replaced readily by the using arm. These parts are specified in pertinent standard nomenclature lists.

b. Accessories.—The accessories provided for the subcaliber weapon are those required for cleaning and preserving as well as for a complete record of the equipment. They include a gun book, cartridge extractor, bore brush, oil gun, cleaning staff, tool roll, etc.

c. Sighting and fire-control equipment.—For information as to the type and use or application of breech and muzzle bore sights which are provided with the 37-mm gun, see chapter 3, section II. Firing tables are also issued which contain firing data required for this type of firing with the 37-mm ammunition.

94. Ammunition.—Subcaliber ammunition is listed in paragraph 65.

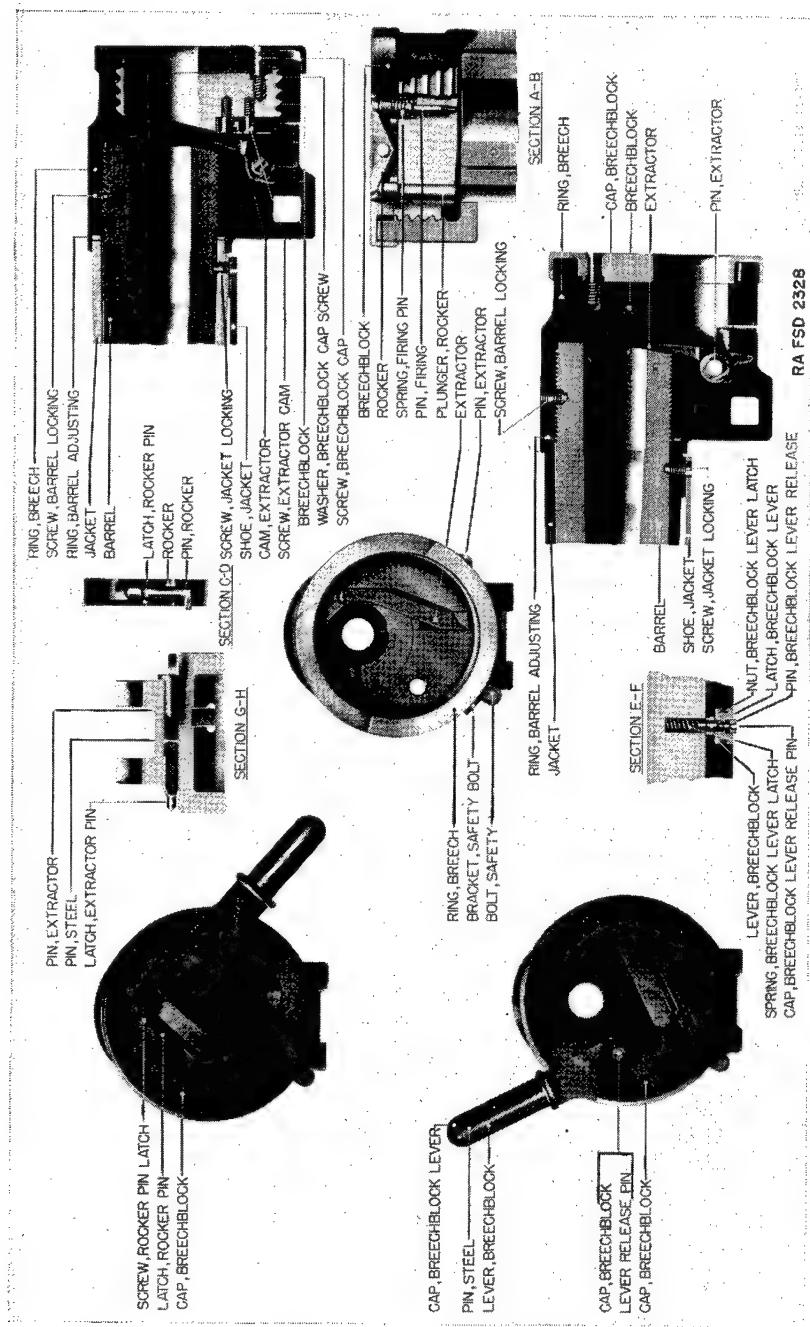


FIGURE 85.—37-mm gun breechblock, rear and sectioned views.

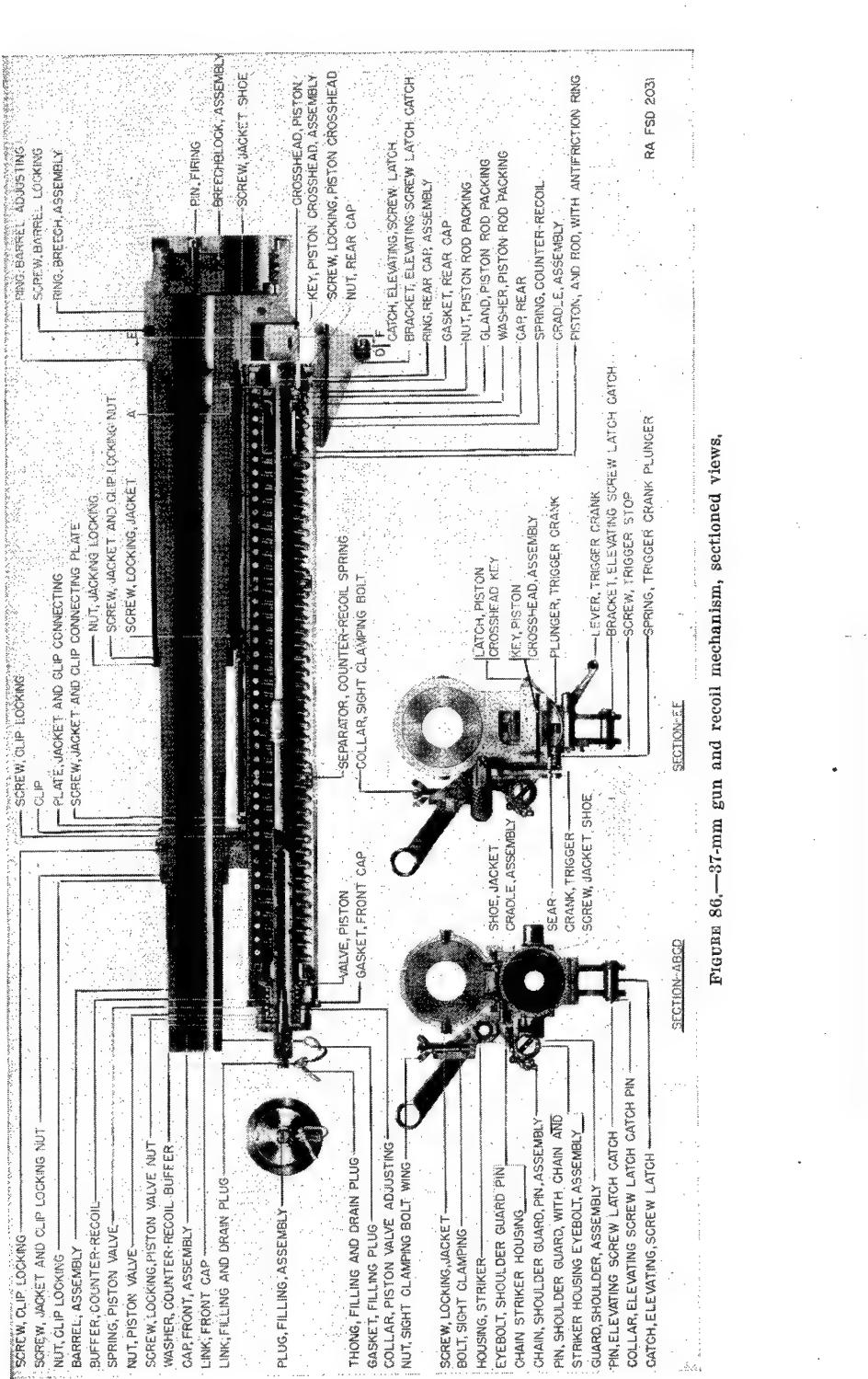


FIGURE 86.—37-mm gun and recoil mechanism, sectioned views.

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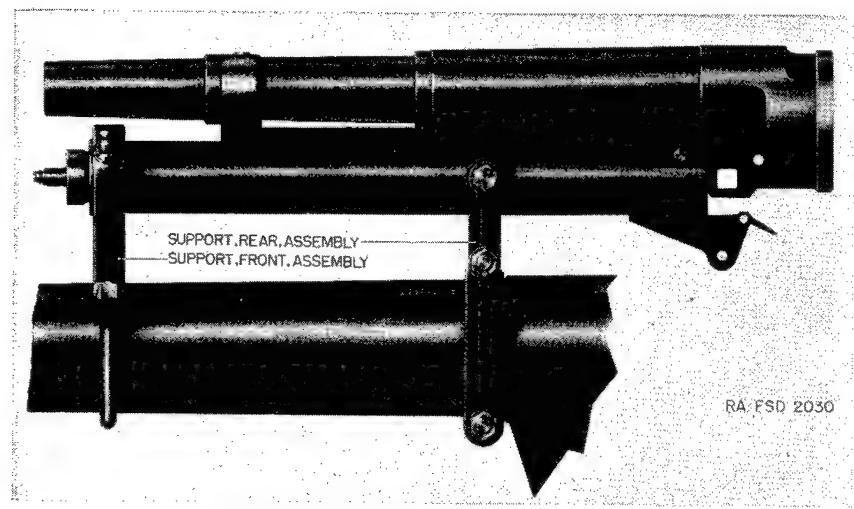


FIGURE 87.—37-mm subcaliber mount, M2.

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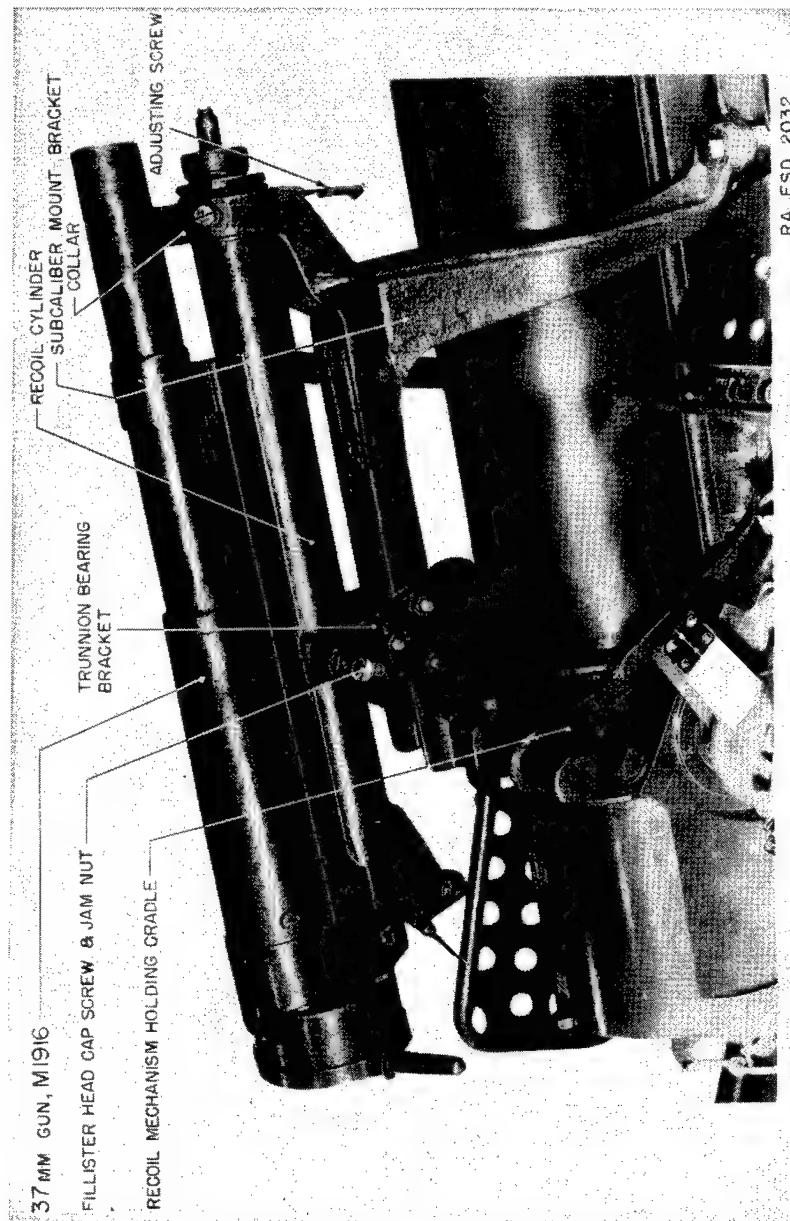


FIGURE 88.—37-mm subcaliber mount, M17.

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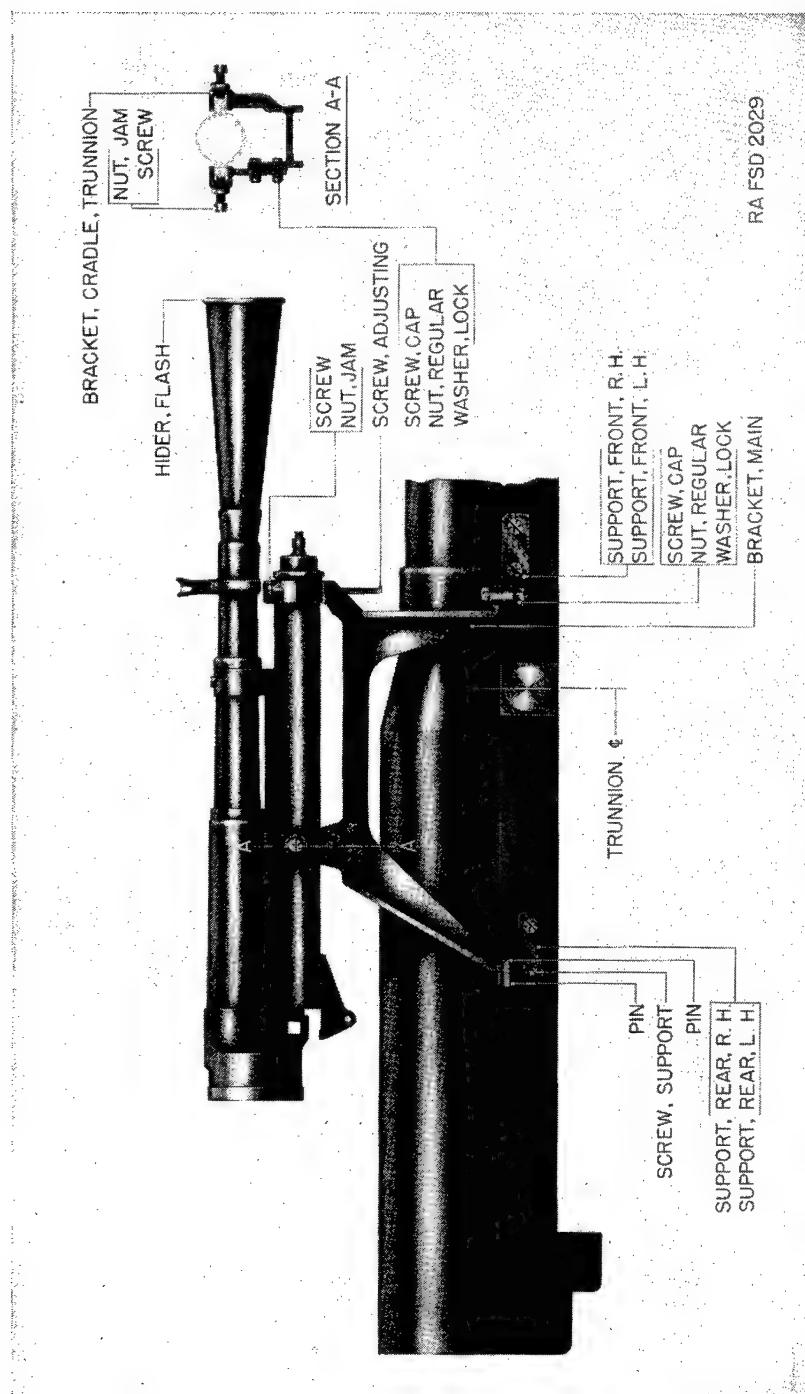


FIGURE 89.—37-mm subcaliber mount, M8.

CHAPTER 8

MATERIAL AFFECTED BY GAS

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Cleaning	96
Transportation	97

95. Protection against phosgene, chlorine, mustard gas, etc.—*a.* For material which is in constant danger of gas attacks whether from gas clouds or gas shells, care will be taken to keep all bright parts of guns, carriages, mountings, and accessories well coated with oil.

b. Sights and all instruments will also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

c. All uncapped fuzes or fuzes which have been removed from their containers will be wiped over with oil as soon as possible and protected with a cover.

d. Practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if sufficient time is given. The mustard gas is absorbed by these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

96. Cleaning.—*a. General.*—All bright parts of guns and carriages, together with all accessories and spare parts exposed to the gas, must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they should be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled must be cleaned and oiled. It is desirable to expend it as soon as possible.

b. Decontamination of material exposed to mustard gas.—The following measures will be taken for the removal of mustard gas from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with mustard gas. For all operations indicated below the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must not be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified but dry chloride of lime may be substituted in event that calcium hypochlorite is not available. After 2 hours or preferably 6 hours if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite is removed in order to prevent the deterioration resulting from its prolonged action. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

(3) Whitewash soiled parts which do not lend themselves to sprinkling with dry powder with a thick paste of calcium hypochlorite made from three volumes of calcium hypochlorite and one volume of water. After 2 hours or preferably 6 hours, wash off the calcium hypochlorite.

(4) The delicate parts of the apparatus such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by calcium hypochlorite will be cleaned by dry polishing with rags. After this operation the rags will be buried.

(5) If there are large quantities of water at hand, in place of calcium hypochlorite use water. The water should be warm, but not boiling, and large quantities should be used. This cannot be done in the case of greasy articles where only calcium hypochlorite will be used.

(6) When it is not necessary to use immediately contaminated material or when above means are not available, it may be considered that the handling material or apparatus is not dangerous after 6 or 8 days.

97. Transportation.—The removal will be effected by automotive units whenever possible. If horse transport must be used, the route will be reconnoitered carefully in order to avoid contaminated ground. The material will be decontaminated as thoroughly as possible before its removal.

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APPENDIX

LIST OF REFERENCES

1. Standard nomenclature lists.

Ammunition, blank, for pack, light, and medium SNL R-5.
field artillery.

Ammunition, fixed, all types, for pack, light, SNL R-1.
and medium field artillery.

Ammunition instruction material for pack, light, SNL R-6.
and medium field artillery.

Caisson, 75-mm gun, M1918; limber, caisson, SNL C-5.
75-mm gun, M1918; and limber, carriage,
75-mm gun, M1918.

Gun and carriage, 37-mm, M1916, and carriages, SNL A-7.
37-mm gun, M1916A1 and M1916A2.

Gun and carriage, 75-mm, M1897MI and SNL C-4.
M1897MIA2.

Gun and carriage, 75-mm, M2A1, M2A2, and SNL C-12.
M2A3.

Gun and carriage, 75-mm, M1897A4----- SNL C-25.

Major items, small arms, automatic gun, trench SNL F-1.
mortar, and field artillery sighting equip-
ment and fire-control instruments.

Material, cleaning and preserving, tools and SNL K-1.
equipment used therewith.

Service fuzes and primers for pack, light, and SNL R-3.
medium field artillery.

Current Standard Nomenclature Lists are as (OPSI).
tabulated here. An up-to-date list of
SNL's is maintained as the "Ordnance Pub-
lications for Supply Index".

2. Firing tables and trajectory diagrams.

Gun, 75-mm, M1897, M1897A1, M1897A2, M1897A3, and M1897A4:

Shell, fixed, chemical, Mk. II, with fuze, P. D., Mk. III, Mk. IV Star, M46, or M47, 75-mm gun, M1897.	FT 75-B-4.
Shell, fixed, HE, Mk. I, with fuze, P. D., Mk. III, Mk. IV, Mk. IV Star, M46, or M47, 75-mm gun, M1897.	
Shell, fixed, practice, sand-loaded, Mk. I, with fuze, inert, P. D., Mk. IV, 25-mm gun, M1897.	FT 75-B-4.
Shrapnel, fixed, Mk. I, 75-mm gun, M1897.	
Shell, fixed, chemical, Mk. II, with fuze, P. D., M35, 75-mm gun, M1897.	FT 75-B-4 (supplement).
Shell, fixed, HE, Mk. I, with fuze, P. D., M35, 75-mm gun, M1897.	
Shell, HE, Mk. I, with fuze, short, Mk. IV, reduced charge, 75-mm gun, M1897.	TD 75-B-2, 2b.
Shell, HE, Mk. I, with fuze, long, Mk. III, normal charge, 75-mm gun, M1897.	TD 75-B-2, 2d.
Shell, HE, Mk. I, with fuze, P. D., M46, M47, reduced charge, 75-mm gun, M1897.	TD 75-B-4, 2b.
Shell, HE., Mk. I, with fuze, P. D., M46, M47, normal charge, 75-mm gun, M1897.	TD 75-B-4, 2c.
Shell, fixed, HE., M48, with fuze, P. D., M48, M54, 75-mm gun, M1897.	FT 75-Z-2. TD 75-Z-2.
Gun, subcaliber, 37-mm, M1916, on subcaliber mount:	
Shell, fixed, practice, Mk. II, with fuze, practice, M38, 37-mm gun, M1916.	FT 37-0-1 (abridged).
Shell, fixed, LE., Mk. I, B. D., with fuze, B. D., Mk. I and Mk. II, 37-mm gun, M1916.	
Shell, fixed, sand-loaded, Mk. I, 100-percent service charge, 37-mm gun, M1916.	FT 37-H-2.

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Current firing tables are as tabulated here.

An up-to-date list of firing tables is maintained in SNL F-69.

3. Technical manuals.

Cleaning and preserving materials ----- TM 9-850 (now published as TR 1395-A).

Pressure gage outfits for cannon ----- TM 9-1870 (now published as Supplement to SNL N-9).

4. Field manuals.

Service of the piece, 75-mm gun, M1897 and M1897A4, horse-drawn and truck-drawn. ----- FM 6-50.

Service of the piece, 75-mm gun matériel, M2. ----- FM 6-55.

37-mm Gun, M1916 ----- FM 23-75.

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[A. G. 062.11 (1-27-41).]		

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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